BEAR LODGE PROJECT
RARE ELEMENT RESOURCES, INC.

License Application for Source Material Possession
Submitted to the U.S. Nuclear Regulatory Commission

Rare Element Resources

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List of Abbreviations and Acronyms

µCi	microcurie
µg/m3	micrograms per cubic meter
µR/hr	microRoentgens per hour
ALARA	As Low as is Reasonably Achievable
ALI	Allowable Limits on Intake
AUs	Authorized Users
BNSF	Burlington Northern Santa Fe
BZ	breathing zone
CEDE	committed effective dose equivalent
COO	Chief Operating Officer
cpm	counts per minute
DACs	Derived Air Concentrations
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EHS	Environmental Health and Safety
ER	Environmental Report
Forest Service	U.S. Forest Service
ft	feet
FWS	U.S. Fish and Wildlife Service
GM	Geiger Mueller
gpm	gallons per minute
Hydromet	Hydrometallurgical
ICRP	International Commission on Radiological Protection
IQR	interquartile range
km	kilometer
LOM	Life of Mine
LQD	Land Quality Division
LS	leach solution
mph	miles per hour
mrem	millirem
MSHA	Mine Safety and Health Administration
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NHTSA	National Highway Transportation Safety Administration

NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NVLAP	National Voluntary Laboratory Accreditation
OSL	optically stimulated luminescent
OxCa	oxide carbonate
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m2/s	picocuries per square meter per second
PLS	pregnant leach solution
PM2.5	particulate matter with effective diameter less than 2.5 microns
PM10	particulate matter with effective diameter less than 10 microns
PPE	personal protective equipment
PUG	physical upgrade
radon	radon-222
REE	rare earth elements
REO	rare earth oxide
RER	Rare Element Resources, Inc.
RSO	Radiation Safety Officer
RSP	Radiation Safety Program
RWP	Radiation Work Permit
SALI	stochastic annual limits on intake
SERP	Safety and Environmental Review Panel
SGCN	Species of Greatest Conservation Need
SOP	Standard Operating Procedure
TEDE	total effective dose equivalent
TLDs	thermoluminescent dosimeters
TREO	total rare earth oxide
TSF	Tailings Storage Facility
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
U.S.	United States
USGS	U.S. Geological Survey
w/w	weight basis
WCRM	Western Cultural Resource Management, Inc.
WDEQ	Wyoming Department of Environmental Quality
WL	working level
WLM	working level months
WNDD	Wyoming Natural Diversity Database
WQD	Water Quality Division
WY	Wyoming
WYDOT	Wyoming Department of Transportation

1.0 SECTIONS 1-4: NRC FORM 313

The format and content of this license application generally follows the recommendations provided in NUREG 1556 Volume 12 *Consolidated Guidance About Materials Licenses. Program-Specific Guidance About Licenses for Manufacturing and Distribution* (U.S. Nuclear Regulatory Commission - NRC, 2000) as suggested to Rare Element Resources, Inc. (RER) by the NRC staff.

Information is contained on NRC form 313 (attached as Appendix A).

RER is requesting a performance-based license consistent with 10 CFR Part 51.22 (c) (11) that will allow RER to perform qualifying actions without further environmental review by the NRC. These qualifying actions meet the following criteria: 1) there is no significant change in the types or significant increase in the amounts of any effluents that may be released off-site; 2) there is no significant increase in individual or cumulative occupational radiation exposure; 3) there is no significant construction impacts; and 4) there is no significant increase in the potential for or consequences from radiological impacts. A Safety and Environmental Review Panel (SERP), described in Section 8.5, will evaluate and determine whether proposed actions meet these qualifying criteria.

2.0 SECTION 2: NRC FORM 313

Please refer to Section 1.0.

3.0 SECTION 3: NRC FORM 313

Please refer to Section 1.0.

4.0 SECTION 4: NRC FORM 313

Please refer to Section 1.0.

5.0 RADIOACTIVE MATERIAL

As required by 10 CFR 40, RER is requesting a radioactive materials license to possess up to 10 curies of unsealed, non-volatile thorium hydroxide and to process unlimited quantities of unsealed, non-volatile source material in any bound form. The source material will be uranium and thorium in their natural isotopic abundance in concentrations greater than 0.05 percent by weight.

A decommissioning Funding Plan, as required by 10 CFR 40.36(a) is provided in Appendix B.

6.0 PURPOSE FOR WHICH LICENSED MATERIAL WILL BE USED

The purpose for which licensed material will be used is for possession of source material incident to the processing of rare earth elements (REE). The type and purpose of the requested licensed material is listed in Table 6.0-1. The pre-concentrate is source material used as feed material to the hydrometallurgical (Hydromet) Plant described in Section 9.0. The thorium hydroxide is a waste product from the Hydromet Plant.

Table 6.0-1
Information about Requested Radioisotopes

Radioisotope	Chemical/Physical Form	Maximum Possession Limit	Proposed Use
Rare earth element mineral pre-concentrates containing natural uranium and thorium.	Any bound form	Unlimited Quantities	Possession of source material incident to the processing of rare earth elements
Natural Thorium	Hydroxide	Up to 10 Curies	Possession of source material incident to the processing of rare earth elements

The operating mine will supplement the global availability of REEs and improve the strategic position of the United States (U.S.) in terms of their use.

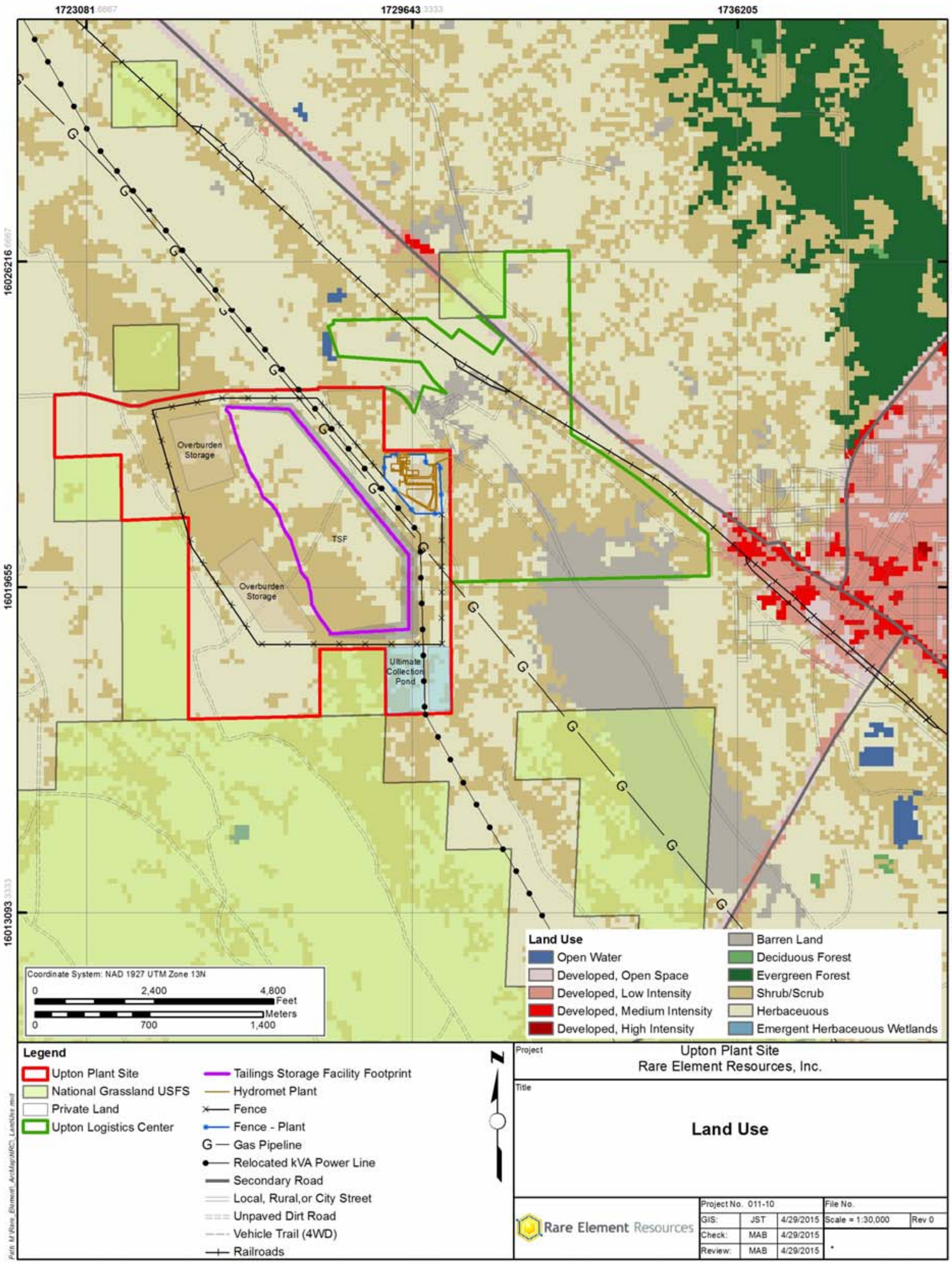
REEs are used in green energy and other high technology applications. Some of the major applications include: hybrid and plug-in electric automobiles, advanced wind turbines, nickel-metal-hydride batteries, computer hard drives, magnetic refrigeration technologies, compact fluorescent light bulbs, metal alloys, additives in ceramics and glass, fluid and petroleum cracking catalysts, and a number of critical military uses.

The need for strategic development of REE has become apparent over the last few years. The U.S. Department of Energy (DOE), for example, has identified lanthanides as a strategic resource. The rationale for the DOE's development of a critical strategy for REE included the U.S. dependence on a sole supplier that is not domestic, the importance of REE in certain defense applications and forecasts for a surge in demand for commercial end uses that could strain global supplies. Recent events in the global market for REE have reinforced the DOE's concern regarding reliable and secure supplies of REE.

China currently produces approximately 96 percent of the approximate 140,000 tons of rare earths consumed annually worldwide and it has been reducing its exports of rare earths each year. The rare-earths market is growing rapidly at 7 to 10 percent per year, and is projected to accelerate if green technologies are implemented on a broad scale.

7.0 SITE CHARACTERIZATION

Information presented in this section is largely a summary of applicable sections of the Environmental Report - ER (RER, 2015) for the Upton Plant Site, submitted as an accompanying document to this license application. Land use for the Upton Plant Site and surrounding area is shown on Map 7.0-1. Baseline environmental data related to the physical upgrade (PUG) plant, located at the Bull Hill Mine Site, can be found in the Plan of Operations (RER, 2014). Environmental impacts of the Bull Hill Mine are being assessed in an environmental impact statement prepared by the U.S. Forest Service (Forest Service).



Map 7.0-1
Land Use

7.1 SITE LOCATION AND LAYOUT

The Bear Lodge Project consists of the following four components:

- An open-pit mine operation at the Bull Hill Mine Site and associated support facilities, located approximately 12 road miles (19.3 kilometers - km) north of Sundance, Wyoming in central Crook County, Wyoming;
- A PUG Plant for mineral pre-concentration, located on-site adjacent to the Bull Hill Mine Site;
- A Hydromet Plant for further concentration and recovery of the REE into a rare earth carbonate concentrate product and Tailings Storage Facility (TSF) at the Upton Plant Site, located approximately 40 miles (64.4 km) south of the Bull Hill Mine Site and 2 miles (3.2 km) northwest of the Town of Upton, Wyoming in north central Weston County; and
- The continuation of exploration drilling at the Bull Hill Mine Site.

Section 9.0 provides details of the site location and layout, including maps and figures.

7.2 Population Distribution

The population in 2010 in the three counties in the vicinity of the Upton Plant Site was 46,113, 7,083, and 7,208 in Campbell, Crook and Weston Counties, respectively. Population densities averaged 9.6, 2.5, and 3.0 persons per square mile in Campbell, Crook, and Weston Counties, respectively. The statewide average was 5.8 persons per square mile (Census Bureau, 2011).The age distribution of the population in these three counties was: highest between 35 and 64 years (39.8 to 42.8 percent), followed by 20 to 34 years (15.0 to 23.7 percent), 5 to 19 years (18.0 to 22.0 percent), over 64 years (5.7 to 16.2 percent), and under 5 years (5.7 to 8.8 percent).

Between 2008 and 2012, racial minorities (i.e., African or Asian American, native Hawaiian and other Pacific Islander, and others) comprised 8.8 and 5.9 percent of Wyoming's and Weston County's populations, respectively. Persons of Hispanic origin (not considered here as a racial minority) comprised 8.9 and 3.1 percent of Wyoming's and Weston County's populations. Low income populations comprised 11.0 and 13.8 percent of Wyoming's Weston County's populations (Census Bureau, 2013).

7.3 HISTORIC, SCENIC, AND CULTURAL RESOURCES

7.3.1 HISTORIC AND CULTURAL RESOURCES

Cultural resources in the vicinity of the Project Area were identified in 2012 and 2013 (Western Cultural Resource Management, Inc. – WCRM (2013).

Fourteen archaeological sites were recorded. Of these, five were previously recorded and nine were newly identified and documented. Of the fourteen, three (48WE614, 48WE1681, and 48WE1682) are historic sites related to habitation, ranching, or resource exploration. One (48WE1675) is a multicomponent site consisting of a historic refuse site and prehistoric lithic scatter. The remaining nine are prehistoric: three are open camps and six consist of lithic scatters. The remaining site was a previously recorded prehistoric lithic scatter that was found to be destroyed.

WCRM recorded 46 isolated resources during the course of the survey. Ten of the isolates are historic; 36 are prehistoric. Based on the observed artifacts, lack of features, and environmental setting (e.g., highly erosive setting, deflated deposition, types of soils) of the sites, none were recommended as eligible for nomination to the National Register of Historic Places (NRHP). The 14 sites and 46 isolated resources recorded were recommended as not eligible for nomination to the NRHP.

Figure 10 in the WCRM report (also Report 10 of the Stand Alone Reports associated with the ER) (RER, 2015) shows the historic and cultural resources within the permit boundary.

In November 2013, the Fort Peck Assiniboine and Sioux Tribe, Northern Arapaho Tribe, Crow Creek Sioux Tribe, and Northern Cheyenne Tribe conducted a tribal survey of the Upton Plant Site area. The results of the survey were documented in a combined tribal report (Ft Peck, N. Arapaho, and Crow Creek) and a separate report from the Northern Cheyenne, transmitted previously to the NRC.

7.3.2 SCENIC RESOURCES

The Upton Plant Site is located on private land bordered by the Upton Logistics Center and the Forest Service's Thunder Basin National Grassland, both near the Town of Upton, Wyoming. There are no visual/scenic resource management guidelines for activities on private land in this area. The adjacent public Forest Service land is managed for scenic resources under its Scenery Management System (Forest Service, 1995). These adjacent public lands are rated for Moderate Scenic Integrity and do not contain popular recreational use attractions. Moderate scenic integrity refers to landscapes where the character of the landscape is altered slightly. Alterations to the landscape must remain visually subordinate to the observable scenery.

Generally, the site is located in an area with viewsheds and landscape characteristics common to the windswept, short-grass prairie of the region. There are some gently rolling hills on the western horizon, easterly views of the Town of Upton and its forested setting, and faint views of the Black Hills toward the far northeast. There are numerous existing paved, gravel, and dirt roads in the vicinity of the site, associated with agriculture and energy development. Highways US 16 and WY 116 are the major, nearby access roads. Several power lines and a rail line are additional linear features in the nearby landscape.

7.4 METEOROLOGY

The climate of the region is broadly characterized as interior continental with hot summers and cold winters. Winds at the Upton Plant Site are predominantly from the south-southeast (spring and summer; and at night) and north-northwest (winter and during the day). Wind speeds are largely 0 to 5.2 meters per second (about 12 miles per hour - mph).

Average annual precipitation is 12.5 inches, with a range of 5.6 to 19.5 inches. Average annual snowfall is 44.1 inches. The mean monthly temperature is highest for July (72.9 degrees Fahrenheit - ^{o}F) and lowest for January (23.5 ^{o}F). Approximately 80 percent of the precipitation each year falls between April and October and occurs primarily as rain. Snow is the primary form of precipitation between November and April.

Severe weather events in Weston County are summarized as follows:

- There were 25, F0 through F2 tornadoes recorded from 1950 to 2003.
- There was an average of approximately 40 thunderstorm days from 1901-1995 (University of Wyoming, 2008).
- There have been 80 severe hail events recorded from 1955 to 2003 (University of Wyoming, 2008).

7.5 GEOLOGY AND SEISMOLOGY

7.5.1 GEOLOGY

The Upton Plant Site is on the west side of the Black Hills uplift where rocks dip southwestward into the Powder River Basin. The site lies on the eastern limb of the Black Hills monocline, which extends northwest-southeast and separates more gently dipping rock on either side of the structure.

The primary surficial geologic unit is the Belle Fourche Shale, which dips gently to the west and is exposed in a one mile wide band that traverses the area. Coyote Creek and Beaver Creek occupy northwest-trending strike valleys in shale formations. Minor outcrops of the overlying Greenhorn Formation (overlying the Belle Fourche Shale) and Carlile Shale are present in the western portion of the area (RER, 2015). An intervening sandstone formation (Turner Sandstone Member of the Carlile Shale) forms a low hogback ridge in the western portion of the project area.

Older geological formations consist of the Mowry Shale (about 200 to 250 feet - ft thick in the region) and the Newcastle Sandstone (20 to 50 ft thick). These units are underlain by the Skull Creek Shale (185 to 210 ft thick) and Inyan Kara Group, which is comprised of the Fall River Formation (130 ft thick) and the Lakota Formation (100 to 125 ft thick). Under this is an additional 3,000 ft of sedimentary rock represents deposition from the Morrison Formation through the Cambrian-Ordovician Deadwood Formation. The top of the Morrison Formation likely occurs at depths between 800 and 1,400 ft within the area (RER, 2015).

7.5.2 SEISMOLOGY

The seismic hazard review for the Upton Plant Site is based on an analysis of available literature and historical seismicity. There are no capable faults (i.e. active faults) with surface expression mapped within or near the site, according to the U.S. Geological Survey (USGS). The closest capable fault to the site is the Stagner Creek fault system located in central Wyoming approximately 185 miles (298 km) to the west-southwest. The faults at Yellowstone National Park are located approximately 275 miles (443 km) to the west-northwest.

7.5.3 SEISMICITY

Natural earthquakes in Wyoming occur as the result of movements on existing or newly created faults or in the magma chamber beneath Yellowstone National Park. No faults have been mapped within 185 miles (298 km) of the Upton Plant Site.

Earthquakes generally do not cause ruptures in ground surfaces unless the magnitude of the event exceeds 6.5. Because of this, areas of Wyoming without active faults exposed at the surface, such as the Upton Plant Site, are generally thought to be incapable of having earthquakes with magnitudes over 6.5. Earthquakes with magnitudes less than 6.5 would cause little damage to specially built structures, but could cause considerable damage to ordinary buildings and severe damage to poorly built structures. Some walls could collapse. Underground pipes would generally not be broken and ground cracking would not occur or would be minor (RER, 2015).

Twenty recorded earthquakes with a magnitude greater than 2.5 (Richter Magnitude Scale) or intensity greater than III (Modified Mercalli Intensity Scale) have been recorded within a 60-mile radius of the Upton Plant Site. Of these, two have occurred in Weston County. The strongest, located approximately 28 miles northwest of Upton, was a magnitude 4.3 earthquake in 1972.

Weston County is in Seismic Zone 0 and Zone 1 of the Uniform Building Code. Upton and the Upton Plant Site are located in Zone 0, in which there is a 90 percent probability that an earthquake with a ground acceleration of 5%g would not occur within any 50-year period. An average peak ground acceleration of 5%g could be applied to non-critical facilities, but is significantly less than values suggested by newer building codes (RER, 2015).

It is assumed conservatively in the ER that, in the interest of public safety, the Upton Plant Site is located in an intensity VI earthquake area (RER, 2015).

7.6 HYDROLOGY

The Upton Plant Site is located in the northern plains of the Cheyenne River Basin (Hydrologic Unit Code 101201). The streams in the immediate area are ephemeral because regionally, evaporation exceeds annual precipitation. Spring runoff, in particular, and snow melt yield the highest flows in the Cheyenne River drainage basin.

The Upton Plant Site is located near the headwaters of Coyote Creek, a tributary to Iron Creek. Coyote Creek flows approximately 5 stream channel-miles (8 km) southeastward to the offsite Iron Creek. Iron Creek is a tributary to Beaver Creek. It flows approximately 11.6 stream channel-miles (18.7 km) to Beaver Creek. Beaver Creek flows approximately 117 stream channel-miles (188.3 km) to where it empties into the Cheyenne River near the Wyoming-South Dakota state line.

The majority of the Coyote Creek drainage area is composed of minor ephemeral stream channels. Its drainage area is approximately 4.48 square miles (12.4 square km). The drainage basin in the vicinity of the Upton Plant Site is composed of rolling plains and rangeland. A hogback ridge runs along the western side of the site. The western side of the hogback ridge drains toward Beaver Creek. The maximum basin relief is approximately 200 ft. Stream channels generally slope at less than 1 percent to 2 percent. Soils within the Upton Plant Site's drainage area are strictly of hydrologic soil group D (RER, 2015).

Surface water is used, at a minimum, for stock watering, irrigation, reservoir supply, domestic needs, and fish propagation (RER, 2015).

Coyote and Iron creeks are classified as 3B streams: i.e., intermittent or ephemeral, incapable of supporting fish populations or drinking water supplies (Wyoming Department of Environmental Quality – Water Quality Division – WDEQ-WQD, 2001).

7.6.1 REGIONAL GEOHYDROLOGY

Sedimentary rocks exposed in the Upton quadrangle are approximately 5,900 ft thick. These rocks overlie as much as 2,800 ft of unexposed sedimentary rocks (RER, 2015).

Adequate supplies for domestic or stock use in Weston County can be developed from wells generally less than a 1,000 ft deep, except in areas underlain by the thick sequence of marine shale that extends from the southeastern to northwestern corners of Weston County (RER, 2015). Wells completed in the shale sequence generally yield small quantities of highly mineralized waters, generally unsuitable for most uses.

The seven geohydrologic units within Weston County include (1) igneous and metamorphic rocks, (2) the marine carbonate and sandstone sequence (Deadwood to Minnelusa formations), (3) red-bed and gypsum sequence (Opeche Shale to Gypsum Spring Formation), (4) marine, marginal marine, and continental sandstone and shale sequence (Sundance through Inyan Kara), (5) marine shale sequence (Skull Creek to Pierre Shale), (6) continental sandstone and shale sequence (Fox Hills to Fort Union Formation), and (7) Quaternary-age alluvium deposits (RER, 2015).

Further discussion is restricted to the primary aquifers in the region: the Deadwood to Minnelusa formations, the Sundance to Inyan Kara, the Fox Hills to Fort Union, and Quaternary deposits.

The Deadwood to Minnelusa unit includes the Late Cambrian and Early Ordovician-age Deadwood Formation, the Ordovician-age Winnipeg Formation and Whitewood Dolomite, the Devonian and Early Mississippian age Pahasapa Limestone (Madison equivalent), and the Pennsylvanian and Early Permian-age Minnelusa Formation. The largest yields in the area occur generally from the Pahasapa Limestone, reported at more than 1,000 gallons per minute (gpm). The second major water-bearing formation is the Minnelusa Formation, with the largest yields of 300 gpm reported in Weston County (RER, 2015).

The Sundance, Morrison, and the Lakota and Fall River formations of the Inyan Kara Group are approximately 650 ft thick in Weston County. Sandstones and conglomerates in the Inyan Kara Group can yield as much as 146 gpm to wells. The Lakota is generally a more productive aquifer than the Fall River, as more wells are drilled deeper to the Lakota to obtain adequate supply, and the Lakota generally supplies higher quality water. Most Lakota wells are flowing at the surface, generally yielding less than 30 gpm, which could be increased by pumping. Yields in the Sundance are similar to the Lakota, though most Sundance wells are shallow and drilled near outcrop (RER, 2015).

The Fox Hills to Fort Union sequence is composed of the marginal marine Fox Hills Sandstone, overlain by the continental deposits of the Late Cretaceous Lance Formation and Paleocene-age Fort Union Formation. Wells are completed in the sandstone intervals of these formations at depths of less than 600 ft. Yields are suitable in quantity and quality for domestic and stock usage.

Alluvium deposits consist of primarily silt, clay, and fine-grained sand in the alluvial valleys of Weston County. They recharge through infiltration of precipitation as well as via surface water infiltration when the ephemeral streams are flowing. Discharge of groundwater in these units is unknown and likely occurs as eventual discharge to further downstream portions of Beaver Creek and via evapotranspiration. Most of the stream valleys are less than a ¼-mile wide, and alluvial deposits are less than 100 ft thick. Reported yields are generally less than 10 gpm, extending up to above 60 gpm in Beaver Creek and Stockade Beaver Creek. The largest yields occur along the Cheyenne River, where yields from 200 to 900 gpm have been reported (RER, 2015).

Shallow groundwater (less than 20 ft) at the Upton Plant Site is limited to accumulations in perched and isolated zones within alluvial valley fill and the weathered upper portion of the Belle Fourche Shale. Five monitoring wells are completed in the valley fill (three wells) and weathered shale (two wells) unit. The unit is not considered an aquifer, as 1) well yields in the fine-grained alluvium and weathered shale are low (based on groundwater sampling) and 2) the waters are highly mineralized and not suitable for any use. Groundwater flow at the Upton Plant Site follows topography to the south in the valley fill and weathered shale.

Deeper groundwater is found several hundred feet below the uppermost Belle Fourche Shale and Mowry Shale, in the Newcastle Sandstone and the Inyan Kara Group. Regionally, the Fall River and Lakota formations of the Inyan Kara Group are referred to as the Dakota Aquifer System. It is noted that the Newcastle Sandstone is a minor unit of the Dakota Aquifer System that also includes the deeper Inyan Kara Group. Below the Newcastle is the underlying Skull Creek Shale. Five monitoring wells are completed in the deeper Newcastle (one of five) and the Dakota Aquifer (four of five).

Recharge to these aquifers is primarily through direct infiltration of precipitation or stream losses in areas of outcrop northeast of the Upton Plant Site, on the southwestern flanks of the Black Hills. Discharge for these confined aquifers is via groundwater withdrawal from wells and eventual discharge to distant areas in eastern North Dakota and South Dakota (RER, 2015). Deeper groundwater flows from the northeast at the upland recharge areas of the Black Hills to the west and southwest into the Powder River Basin, eventually flowing northward.

The Hydromet Plant is expected to use 212 gpm of water from the Town of Upton. No groundwater wells will be used to supply water to the Hydromet Plant.

7.6.2 WETLANDS

The majority of the wetlands on the Upton Plant Site are in its northeast corner and eastern portion. Isolated wetlands also occur in the central and southern portions of the site. Approximately 15 acres of wetlands are present, about 7.9 acres of which were observed along and within Coyote Creek. Approximately 2.97 acres were associated with the man-made impoundments located on an unnamed tributary of Coyote Creek. A small seep also was identified and encompassed approximately 0.3 acres. Approximately 0.5 acres of wetlands were identified along the unnamed tributary of Beaver Creek.

Approximately 3.35 acres of isolated wetlands were observed surrounding the reservoirs resulting from the reclamation of the bentonite mine.

There are no jurisdictional wetlands at the Upton Plant Site. The ER indicates that a U.S. Army Corps of Engineers-approved jurisdictional determination states Coyote Creek and its adjacent wetlands and waters do not meet the Significant Nexus standard when evaluating their relationship to the nearest traditional navigable water.

7.6.3 IMPACTS TO HYDROLOGICAL RESOURCES

7.6.3.1 Surface Water

Potential surface water impacts could occur during construction, primarily from activities such as the development of the access road, utilities, TSF, and Hydromet Plant. Impacts could occur via vegetation removal, topsoil stockpiling, and limited periods of low impact stream channel disturbance. These activities have the potential to result in minor hydrocarbon spills, primarily related to fuel and lubricants from heavy equipment operation.

Surface water quality within the project area has the potential to be adversely impacted by increasing suspended sediment concentrations due to vegetation removal and soil disturbance. Temporary sediment control features will be used during construction until vegetation can be re-established, to minimize the potential impacts to surface water.

Surface water runoff from direct precipitation within the lined TSF will be directed during operations into a stormwater collection channel between the dry stack tailings out-slope and TSF toe berm embankment and conveyed to the collection pond. Erosion control measures will be placed along the dry stack tailings out-slope and elsewhere as required to prevent the erosion of the dry stack and TSF toe berm embankment material and reduce sediment transport into the collection pond.

Sediment yield and stormwater runoff have the potential to increase during closure due to disturbances associated with equipment and structure removal and site reclamation. Surface water impacts during closure will be minimized through implementation of sediment control. After closure, no impacts are anticipated because the site will be restored to the approximate pre-mine conditions.

Stream channels within the project area will be minimally impacted from construction. Roads will be constructed away from drainages where possible. In the instances where it is necessary to cross a stream channel, the crossing will be made perpendicular to the channel and will include a culvert capable of passing the runoff resulting from a 10-year, 24-hour precipitation event. Crossings of ephemeral channels will involve minimal disturbance and will not occur during flow events. The potential impacts to surface water from ephemeral channel crossings will include increased sediment load due to vegetation and soil disturbance. Sediment load will be mitigated by sediment control measures.

The proposed facilities will be constructed near an ephemeral stream channel and will have the potential to affect surface water quality and flow. A flood control diversion channel will be constructed around the TSF to route surface water flow around the facilities up to and including a 100-year, 24-hour precipitation event. The diversion channel will reduce the risk of flooding and surface water contamination.

Potential impacts from accidental spills and leaks will be small due to their small volume, rapid cleanup response and siting construction activities away from surface water features when possible. In addition, there are no waters receiving effluents because the facility is designed to have no discharges. Process controls will be used throughout the facility to prevent the release of liquids from tanks and processes. Finally, equipment and vehicle maintenance will be performed in the maintenance shop, which will recycle liquid effluents.

Three surface water rights within the project area may be impacted by the TSF. These are the Brainerd Reservoir and ditches. It appears that these structures may have been associated with a spreader dike system in Coyote Creek. It does not appear that these are currently in use because most of the structures have been removed by flows in Coyote Creek. Coyote Draw Stock Reservoir also is located within the project area, but it will not be affected.

7.6.3.2 Groundwater

The potential for groundwater impacts during construction, operations, and closure at the Upton Plant are small and related primarily to the potential for accidental spills and leaks (e.g., equipment leaks). Spills and leaks will be handled in an appropriate manner to reduce or eliminate contamination. Impacts due to spills and leaks will primarily affect shallow hydrologic units throughout the site. The shallow groundwater (less than 20 ft) in the project area is limited to accumulations in perched and isolated zones within the alluvial valley fill and weathered portion of the surficial geologic formation and is not listed as an aquifer as discussed in Section 3.5. As indicated in Section 3.4, the permeability of the Belle Fourche Shale is very low; therefore, the potential for groundwater contamination is minimal.

Water supply for the Upton Plant Site, the majority of which will be recycled, will be obtained from the Upton Municipal Water Network. Therefore, consumptive use of and associated impacts to groundwater are not anticipated. No groundwater rights will be affected by the proposed facility because no groundwater will be used there.

7.7 ECOLOGY

The prairie grasslands in which the Upton Plant Site is located have among the warmest and longest growing seasons of Wyoming’s habitat types, as well as relatively deep and well developed soils. They receive relatively high summer precipitation. These factors result in grasslands having high primary productivity when compared to other Wyoming habitat types.

Most of Wyoming’s grasslands are classified as either shortgrass prairie or mixed-grass prairie. Buffalo grass and blue grama are the two predominant grass species in shortgrass prairie. Mixed-grass prairie is common across much of eastern Wyoming. It typically receives more moisture and has greater plant species diversity than shortgrass prairie. Common mixed-grass prairie plant species include needle-and-thread, western wheatgrass, blue grama, Sandberg's bluegrass, prairie Junegrass, upland sedges, and Indian ricegrass (RER, 2015).

Grasslands are characterized by frequent and occasionally intense natural disturbances including drought, fire, grazing, and occasionally short growing seasons (RER, 2015). These factors have encouraged the predominance of perennial grasses with a substantial number of sedges and herbaceous forbs.

Much of Wyoming's prairie grasslands is unsuited for farming; however, the abundant grazing resource led to the establishment of cattle and sheep ranches. Today, the majority of Wyoming's prairie grasslands are incorporated within privately owned ranches. The predominance of large ranches and Wyoming's relatively low population density have allowed grasslands to persist in a relatively intact state when compared to other regions of the country.

Six dominant vegetation communities were identified within the permit area and include 1) Mixed Shrubland, 2) Greasewood Shrubland, 3) Big Sagebrush Shrubland, 4) Upland Grassland, 5) Meadow Grassland, and 6) Reclaimed Grassland (BKS, 2014). Disturbed areas, or lands disturbed by human activities, and water were also identified and mapped. Scientific names of plant species discussed in this section are provided in Appendix G of the ER (RER, 2015).

According to the pre-assessment weed inventory presented in the ER, Canada thistle was the only state designated noxious weed observed within the Big Sagebrush Shrubland, Meadow Grassland, and Mixed Shrubland vegetation communities. Three Weston County declared weeds were encountered during the survey.

The ER identifies the potential occurrences of Federally Listed Threatened and Endangered Species and Proposed (Candidate) Species and Wyoming Species of Greatest Conservation Need (SGCN).

The project area is within the Section 7 consultation ranges (U.S. Fish and Wildlife Service - FWS, 2014) for Ute ladies'-tresses orchid (*Spiranthes diluvialis*, threatened species), northern long-eared bat (*Myotis septentrionalis*, threatened species), and greater sage-grouse (*Centrocercus urophasianus*, candidate species). No individuals or populations of Ute ladies'-tresses were found during field surveys, and based on the lack of suitable habitat characteristics, local habitats in the project area were confirmed unsuitable for Ute ladies'-tresses (BKS, 2014). No substantial amounts of woodlands and prominent rocky features are present within the project area; therefore, no surveys for bats were conducted (ICF, 2014). The northern long-eared bat's presence was reported as unlikely based on the absence of suitable habitat in the project area and distances of known occurrences from the project area. The greater sage grouse was observed (a maximum of 70 birds were reported on March 1, 2012) in the surrounding wildlife survey area but not within the project area. The surrounding vicinity clearly supports sage-grouse throughout the annual cycle. Several moist drainages throughout the baseline wildlife survey area (e.g., Beaver Creek, McCrady Draw, and Coyote Creek) could provide brood-rearing and late summer habitat (ICF, 2014) and sagebrush vegetation west of the project may provide habitat for nesting and wintering sage-grouse.

There are 28 bird species that are SGCN. Ten species were documented within the baseline wildlife survey area and records of three others within the vicinity of the project area were provided by the WNDD (2014). Many of those species' occurrences were judged as "possible" even though they were not observed during baseline wildlife surveys. Other species' occurrences in the project area were judged "unlikely" because suitable habitats (coniferous woodlands, extensive emergent vegetation) or specific habitat features (high cliffs) do not occur on or near the project area.

There are eight species of mammal, one reptile, two amphibians, and one fish species that are SGCN. During wildlife surveys (ICF, 2014), one amphibian species was detected incidentally on-site; that observation is supplemented by records of species within the project area vicinity provided by the WNDD (2014) and other supplemental sources noted above.

One hundred sixty seven species of birds listed as Nearctic and Neotropical migratory birds by the FWS, Division of Bird Habitat Conservation, and protected under the MBTA (FWS, 2010) have been observed within 50 miles from the project area during the past 20 years. Of those 167 bird species, 83 species are known to occur or might occur in habitats present on or adjacent to the project area. Trends for four species in the local surrounding area indicate their populations have been decreasing during the past 20 years, while populations for 19 species appear to be increasing. Data for 43 other species indicate their populations have been relatively stable.

Raptor species observed (not nesting) in the project area include bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), and burrowing owl (*Athene cunicularia*). Rough-legged hawks (*Buteo lagopus*) were also observed but are present only during winter. Nesting within the wildlife survey area was confirmed for golden eagle, red-tailed hawk, and burrowing owl (ICF, 2014). None of the active raptor nests is within the Upton Plant Site permit area.

The wildlife baseline survey also considers big game, upland game birds and turkeys, migratory game birds, small game, and furbearing animals. In addition aquatic species are addressed in the ER.

Impacts to vegetation are expected via direct removal of vegetation, project-related off-road travel; and dust generation and suppression. An estimated 7.43 acres of vegetation communities is expected to be disturbed (RER, 2015).

RER is proposing the following Project Design Features to reduce effects to vegetation:

- Native vegetation will be retained to the maximum extent possible during construction.
- Disturbed soil will be re-vegetated in a manner that optimizes plant establishment for that specific site or vegetation community.
- Re-vegetation will include one or more of the following: topsoil replacement, planting, seeding, fertilization, liming, and placement of weed-free mulch, as necessary.
- Re-vegetation will start as soon as practical, after termination of ground disturbance.

RER will implement a vegetation monitoring program, the goal of which will be to stabilize reclaimed areas and establish a productive vegetative community in accordance with the designated post-mining land use of wildlife habitat. The ER described the scope of the program (RER, 2015).

7.8 BACKGROUND RADIOLOGICAL CHARACTERISTICS

RER conducted a baseline radiological investigation of the Upton Plant Site in support of the proposed development.

The radiological investigation and monitoring program by extension has established the baseline condition of the Upton Plant Site including 1) concentrations of radionuclides and lanthanides (cerium and lanthanum) in airborne particulates and gases (i.e. radon-222 - radon), surface soil, surface water, and groundwater, 2) gamma exposure rates, and 3) radon flux from soil surface to assess future potential impacts to human health and the environment during project construction, operation, and closure. Radiological impacts incurred during the development and operation of the Upton Plant Site, if any, will be evaluated in part by comparing the data sets of the baseline and operational monitoring. The monitoring of particulate matter (particles with effective diameter less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$), unrelated to radiological monitoring but relevant to pre-operational site conditions, was addressed in this investigation.

It is anticipated that radon, natural uranium and thorium, radium-226, and radium-228 will be the primary radionuclides of potential concern in assessments of exposure pathways. The determination of baseline concentrations of radionuclides in vegetation and wildlife species was not conducted, because RER will be able to more rapidly detect impacts to air, soil, and water resources from mine operations than from vegetation.

The work, conducted in June 2012 with continued air monitoring through 2014, addressed radon concentrations in air and baseline radionuclide concentrations in soils; and associated radon flux and gamma exposure rates. Baseline radionuclide concentrations in groundwater and surface water are addressed and reported in the Mine Permit Application.

The results of the baseline field investigation documented herein indicate the following at the Upton Plant Site:

- The central tendency and variability of measured gamma count rates can be described non-parametrically by the median and the interquartile range (IQR), respectively. The median of the population is 16,091 counts per minute (cpm). The IQR encompasses the range between the 1st quartile (the first 25 percent of ascending, ranked values) and 3rd quartile (the first 75 percent of ascending, ranked values). The IQR is 2,405 cpm (or 17,092 less 14,687 cpm).

- The relationship between gamma count and exposure rates is highly predictable. The range of predicted exposure rates is 10.1 and 19.3 microRoentgens per hour (μR/hr), with a central tendency of 13.8 μR/hr.

- The medians of the predicted concentrations (1.6 picocuries per gram - pCi/g) of radium-226 and natural thorium (2.7 pCi/g) are in good agreement with the median of the laboratory results (1.6 and 2.4 pCi/g, respectively). This indicates that gamma surveys can effectively predict radium-226 and natural thorium concentrations in soil.

- The largely homogeneous distribution of radium-226 and natural thorium concentrations is indicated by the low variability in gamma count rates at the Upton Plant Site.

- Because applicable NRC soil cleanup criteria are likely to be based both on radium-226 and radium-228, both radionuclides should be considered in investigations conducted during operation and closure.

- The measured radon flux rates range from 0.20 to 1.22 picocuries per square meter per second ($pCi/m^2/s$). For comparison purposes, these values are below the NESHAPS (National Emission Standards for Hazardous Air Pollutants) requirement of 20 $pCi/m^2/s$ specified in 10 CFR 40, Appendix A, Criterion 6. Although the requirement applies to uranium mill tailings and thus is not directly germane to this characterization, it is useful as a context to demonstrate the magnitude of baseline radon flux levels measured at the Upton Plant Site.

- Quarterly dosimetry measurements ranged on average from 23.9 to 29.5 millirem (mrem).

- Quarterly radon measurements ranged on average from 0.7 to 1.6 picocuries per liter (pCi/L).
- Particulate radionuclide concentrations in air across the site are consistently low and at levels at least 99 percent below their respective 10 CFR 20 Appendix B effluent concentrations. The ranges of airborne radioactive particulate concentrations were the following percentages of their respective 10 CFR 20 Appendix B effluent concentrations:
    - Natural uranium: not detected to 0.004 percent.
    - Natural thorium: not detected to 0.009 percent.
    - Thorium-230: not detected to 0.4 percent.
    - Radium-226: not detected to 0.03 percent.
- Site-wide average cerium and lanthanum particulate concentrations in air are 9.0×10^{-4} and 4.5×10^{-4} micrograms per cubic meter ($\mu g/m^3$), respectively. The range of cerium concentrations is 6.5×10^{-6} to 4.0×10^{-3} $\mu g/m^3$. The range of lanthanum concentrations is 3.6×10^{-6} to 2.0×10^{-3} $\mu g/m^3$.
- PM_{10} and $PM_{2.5}$ measurements have been collected at the Upton Plant Site. PM_{10} concentrations range from 7.4 to 17.4 percent of the respective standard. Three years of data are needed to compare site measurements to the applicable $PM_{2.5}$ standard.
- Radiological impacts incurred during the development and operation of the Hydromet Plant and TSF, if any, will be determined by comparing the data sets of this baseline and future surveys.

7.9 TRANSPORTATION

7.9.1 ROADWAY SYSTEMS

Interstate-90, US 85, and WY 59 are the major roadways that connect the Upton Plant Site with the remainder of Wyoming and surrounding states.

Map 3.3-1 in the ER shows the primary roads that will be used to access the Upton Plant Site, including Interstate-90, WY 116, and US 16. Secondary access for workers commuting from the Pine Haven area will include US 14 and WY 113. Northwest of the site, US 16 exits Interstate-90 at Moorcroft (Exit 154). To the northeast, WY 116 exits Interstate-90 at Sundance (Exit 185). Interstate-90 is a four-lane divided highway and US highways 14 and 16 and state highways 113 and 116 are paved, two-lane rural highways. Buffalo Creek Road is the only Weston County road that will used to access the Upton Plant Site. To the north, Buffalo Creek Road intersects US 16 as Weston CR 20A and to the south, Buffalo Creek Road intersects WY 116 as Weston CR 20.

7.9.2 TRAFFIC PATTERNS

Traffic volumes between 2010 and 2013 were highest on Interstate-90, followed by US 16 between Moorcroft and Newcastle. The highest proportions of truck traffic are on WY 116 between Sundance and Upton (20 percent) and Interstate-90 (15 percent) (RER, 2015).

The traffic count on US 16 immediately north of the Buffalo Creek Road (Weston CR 20A) turn-off was 1,481 on April 24, 2014. The traffic count on WY 116 immediately east of the Buffalo Creek Road (Weston CR 20) turn-off was 432 (RER, 2015).

7.9.3 RAILROADS

Rail lines link the Upton Plant Site with Montana, Idaho, and Washington to the northwest; eastern Wyoming, Colorado, and New Mexico to the south; and South Dakota, Nebraska, and midwestern and eastern states to the southeast. The highest volumes of coal from the Power River Basin originate on the southern rail line between the Donkey Creek station near Gillette and Shawnee station east of Douglas in Converse County, which is jointly owned and operated by Burlington Northerern Santa Fe (BNSF) and Union Pacific Railroad. Rail traffic on the line includes up to 88 loaded coal unit trains per day, with between 125 and 150 cars per train (BNSF, 2011).

Current levels of rail traffic in the Upton Logistics Center vary on a weekly and monthly basis. Rail traffic in the Logistics Center averages an estimated 10 in-bound and 45 out-bound train cars per week (RER, 2015).

7.9.4 IMPACTS TO TRANSPORTATION

Direct effects to transportation include increased project-related traffic on road segments that will be used to access the Upton Plant Site. Indirect effects include needs for increased roadway maintenance, a potential increase in highway crashes, and potential impacts on workers and the public from transporting the thorium hydroxide waste product from the Upton Plant Site to Richland, Washington. Other potential effects from the projected increase in traffic, including noise levels, visual aesthetics, dust generation, and vehicle/wildlife collisions, are discussed in the ER (RER, 2015).

Traffic associated with the construction of the Upton Plant Site will include light vehicles (e.g., for workers) and heavy trucks delivering construction equipment and supplies. Traffic will increase during the construction of the Upton Plant on the following roads (including segments), with accompanying projections:

- Interstate-90 from Gillette to the South Dakota border: at most 1.9 percent (total trips) and 4.7 percent (truck trips)
- US 16 from Moorcroft to Newcastle: at most 8.1 percent (total trips) and 19.0 percent (truck trips)
- WY 116 from Sundance to Upton: at most 12.6 percent (total trips) and 5.0 percent (truck trips)
- WY 116 from Upton to Buffalo Creek Road (Weston CR 20): at most 44.6 percent (total trips) and 124.3 percent (truck trips)

Traffic associated with operations will include 1) trucks transporting pre-concentrate from the Bull Hill Mine Site to the Upton Plant Site; 2) light vehicles transporting personnel to and from the two sites; and 3) trucks delivering chemicals and other materials to the Hydromet Plant. Trucks transporting the final total rare earth oxide (TREO) product and thorium hydroxide waste product from the Upton Plant Site will travel irregularly, yielding a minimal amount of outbound traffic. Traffic will increase during the operation of the Upton Plant Site on the following roads (including segments), with accompanying projections:

- Interstate-90 from Gillette to the South Dakota border: at most 0.2 percent (total trips) and 1.1 percent (truck trips)
- US 16 from Moorcroft to Newcastle: at most 4.1 percent (total trips) and 9.6 percent (truck trips)
- WY 116 from Sundance to Upton: at most 14.2 percent (total trips) and 45.0 percent (truck trips)

- WY 116 from Upton to Buffalo Creek Road (Weston CR 20): at most 22.5 percent (total trips) and 97.3 percent (truck trips)

Traffic related to closure of the Upton Plant Site will include worker vehicles, trucks transporting TSF cover materials to the Upton Plant Site, and trucks hauling demolished materials away for disposal or recycling. Project-related traffic to and from the Upton Plant Site will vary depending on the number of workers at the site, and is estimated at 44 one-way trips per day.

Traffic associated with closure will likely originate in the local area and be heaviest on WY 116 between Upton and Buffalo Creek Road (Weston CR 20) and on US 16 between Upton and Osage, where the Central Weston County Solid Waste District landfill is located. The peak number of daily trips associated with closure is approximately 7 to 11 percent of 2013 traffic levels on WY 116 and approximately 1 to 3 percent of 2013 traffic levels on US 16. Based on Wyoming Department of Transportation's (WYDOT's) projected traffic increases on WY 116 and US 16 through 2020, the peak number of daily trips during closure is expected to increase traffic on affected roadways by less than 5 percent.

Approximately 1,880,514 miles will be traveled on regional roads during each year of operations, under the assumptions concerning the origin of traffic traveling to and from the Upton Plant Site during operations described above. Approximately two vehicular crashes could be associated with annual operational traffic, based on 2013 accident rates. Approximately 0.02 of these crashes could result in a fatality, using the National Highway Transportation Safety Administration's (NHTSA's) 2012 fatal accident rate in Wyoming. This corresponds to approximately one fatal accident every 40 years.

Approximately 580,008 miles would be traveled during closure, assuming peak traffic levels during the closure of the Upton Plant Site would occur between Moorcroft and Osage 5 days per week for 1.5 years. An estimated 0.19 vehicular crashes would be associated with the closure of the site, applying 2013 accident rates to these miles. Based on the National Highway Traffic Safety Administration's (NHTSA's) 2012 fatal accident rate in Wyoming, approximately 0.01 of these crashes (or 1 in 1,000) could result in a fatality. Historically, vehicle accident rates have fallen over time, and future accident rates are likely to vary substantially from current ones. Nonetheless, these estimates suggest that the risks of vehicular crashes associated with Upton Plant Site closure are likely to be low.

No significant dust or fume emissions are expected during routine shipments of chemicals, fuel, and other hazardous materials to the Upton Plant Site or from off-site shipments of the final TREO product. Therefore, no significant non-radiological risks and/or health related impacts to drivers or members of the public are expected from the routine transportation of chemicals, other hazardous materials, and the TREO product.

7.9.5 TRANSPORTATION EMERGENCIES

Transportation crashes that occur off-site will be handled by the appropriate off-site emergency responders (e.g., Wyoming Highway Patrol) and contracted emergency responders.

The final TREO product will be shipped from the Upton Plant Site to market destinations via truck or rail. Because the TREO is a high value, low volume product, any product shipments by rail will not result in an increase in rail traffic. Therefore, railroad systems will not be impacted.

8.0 INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCES

The roles and responsibilities of executive management, Radiation Safety Officer (RSO), radiation protection staff, users and others in the restricted areas are discussed in the sections that follow. The roles and members of the SERP also are discussed.

8.1 ORGANIZATIONAL STRUCTURE

Figure 8.1-1 is an organizational chart depicting the management structure by function, reporting paths, and flow of authority between executive management and the RSO.

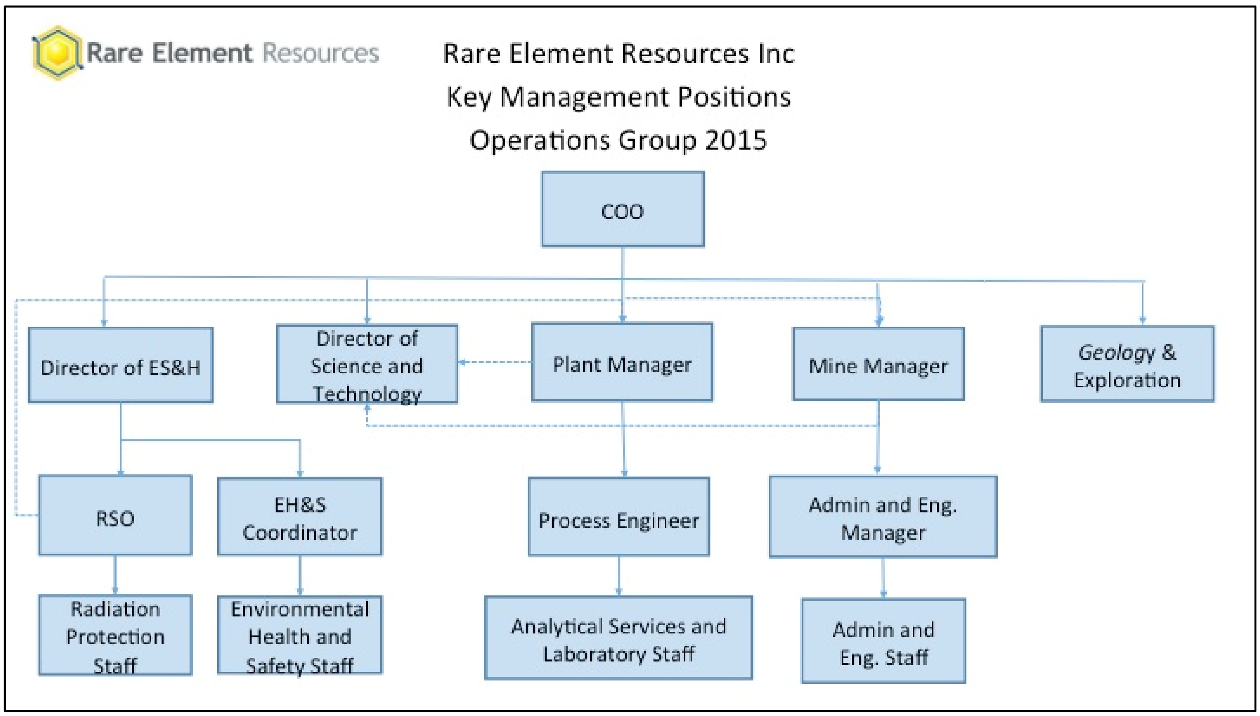


Figure 8.1-1
Key Management Positions at Rare Element Resources, Inc.

8.2 EXECUTIVE MANAGEMENT

The roles and responsibilities of RER Executive Management regarding use and licensing of radioactive materials is described below.

8.2.1 CHIEF OPERATING OFFICER

The Chief Operating Officer (COO) is empowered by the RER Board of Directors to have the responsibility and authority for the radiation safety and environmental compliance programs at all RER facilities. The COO is directly responsible for ensuring that RER personnel comply with corporate industrial and radiation safety; and environmental protection programs. The COO is also responsible for company compliance with all regulatory license conditions/stipulations, regulations, and reporting requirements. The COO has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employees, public health, or the environment, or a violation of state or federal regulations. The COO has the authority to allocate corporate resources (e.g., capital equipment, personnel, and funds) to ensure corporate environmental, health, and safety goals and directives are met.

8.2.2 DIRECTOR, ENVIRONMENTAL HEALTH AND SAFETY

The Director of Environmental Health and Safety (EHS) is responsible for all radiation protection, health and safety, and environmental programs for RER and ensuring these programs meet applicable regulatory requirements and industry best management practices. The Director of EHS is responsible for ensuring that all company operations comply with all applicable laws and regulations. The Director of EHS reports directly to the COO.

8.2.3 MINE MANAGER AND PLANT MANAGER

The Mine Manager (Bull Hill Mine Site) and Plant Manager (Upton Plant Site) will be responsible for all operations at the respective Bull Hill Mine and Upton Plant Site. The Mine Manager/Plant Manager will be responsible for compliance with all applicable laws and regulations and the corporate health, safety and environmental programs. The Mine Manager/Plant Manager will have the authority to terminate immediately any operation of the facility that is determined to be a threat to employees, public health, or the environment, or a violation of laws or regulations. The Mine Manager/Plant Manager will report directly to the COO. The Mine Manager/Plant Manager has the authority to allocate facility resources (e.g. capital equipment, personnel, and funds) to ensure corporate environmental, health, and safety goals and directives are met. The Mine Manager/Plant Manager will act promptly on recommendations made by the RSO to correct deficiencies identified in the radiation or environmental monitoring programs.

8.3 RADIATION PROTECTION STAFF

The roles, responsibilities, and qualifications of the radiation protection staff regarding use and licensing of radioactive materials are described below.

8.3.1 RADIATION SAFETY OFFICER

The RSO is primarily responsible for the technical adequacy and correctness of the radiation protection and As Low as is Reasonably Achievable (ALARA) programs and has continuing responsibility for surveillance and supervisory action in the enforcement of these programs. The RSO will be responsible for the radiation protection and ALARA programs at both the PUG Plant and Hydromet Plant.

The RSO will have the following education, training, and experience:

- A bachelor’s degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university or an equivalent amount of training and relevant experience in radiation protection at a source material facility. Two years of relevant experience are considered equal to 1 year of academic study;
- At least one year of work experience relevant to source material operations in applied health physics, radiation protection, industrial hygiene, or similar work. This experience should involve hands-on work with radiation detection and measurement equipment;
- At least four weeks of specialized classroom training in health physics specifically applicable to uranium recovery; and
- The RSO shall attend refresher training in health physics every 2 years.

The responsibility and authority of the RSO includes to:

- Ensure that licensed material possessed by the licensee is limited to the types and quantities of licensed material listed on the license;
- Maintain documentation that demonstrates that the dose to individual members of the public does not exceed the limit specified in 10 CFR 20.1301;
- Ensure security of licensed radioactive material;
- Post documents as required by 10 CFR Parts 19.11 and 21.6;
- Ensure that licensed material is transported in accordance with applicable NRC and DOT (U.S. Department of Transportation) requirements;
- Ensure that radiation exposures are ALARA;
- Immediately terminate any unsafe condition or activity that is found to be a threat to public health and safety or property;
- Supervise decontamination and recovery operations;
- Maintain other records not specifically designated by license;
- Hold periodic meetings with, and provide reports to, licensee management;
- Ensure that all workers are properly trained;
- Perform periodic audits of the Radiation Safety Program to ensure that the licensee is complying with: all applicable NRC regulations, the terms and conditions of the license (e.g., leak tests, inventories, possession or possession and use limited to trained, approved users, etc.), the content and implementation of the Radiation Safety Program to achieve occupational doses and doses to members of the public that are ALARA in accordance with 10 CFR 20.1101, and the requirement that all records be properly maintained;
- Ensure that the results of audits, identification of deficiencies, and recommendations for change are documented (and maintained for at least 3 years) and provided to management for review and ensure that prompt action is taken to correct deficiencies;
- Ensure that the audit results and corrective actions are communicated to all personnel who possess or possess and use licensed material;
- Ensure that all incidents, accidents, and personnel exposure to radiation in excess of ALARA or 10 CFR Part 20 limits are investigated and reported to NRC and other appropriate authorities, if required, within the required time limits;
- Oversee all activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is possessed or possessed and used;
- Act as liaison with NRC and other regulatory authorities;
- Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility, pursuant to 10 CFR Parts 19 and 20, and any other applicable regulations;
- Oversee proper delivery, receipt, and conduct of radiation surveys for all shipments of radioactive material arriving at or leaving from the site, as well as packaging and labeling all radioactive material leaving the site;
- Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor personnel radiation exposure and bioassay records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching established limits, and recommend appropriate remedial action;
- Conduct training programs and otherwise instruct personnel in the proper procedures for handling radioactive material prior to possession or possession and use, both at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.;

- Supervise and coordinate the radioactive waste disposal program, including effluent monitoring and recordkeeping on waste storage and disposal records;
- Oversee the storage of radioactive material not in current use, including waste; and
- Perform or arrange for leak tests on all sealed sources and calibration of radiation survey instruments.

8.3.2 SAFETY TECHNICIAN

The safety technician shall demonstrate a working knowledge of the proper operation of health physics instruments used in the source material facility; surveying and sampling techniques, and personnel dosimetry requirements. The safety technician, along with the RSO, will implement the requirements of the radiation protection program at the PUG and Hydromet plants. It is expected that the technician will spend 70 percent of his/her at the Hydromet Plant and 30 percent at the PUG Plant.

The safety technician will have one of the following combinations of education, training, and experience:

- Option 1
  - Education: a minimum of an associate degree or two years of study in the physical sciences, engineering, or a health-related field;
  - Training: A minimum of four weeks of training (up to two weeks may be on-the-job training) in radiation protection applicable to source material facilities; and
  - Experience: One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures applicable to a source material facility.
- Option 2
  - Education: A high school diploma;
  - Training: At least three months of specialized training (up to one month may be on-the-job training) in radiation protection relevant to source material facilities; and
  - Experience: Two years of relevant work experience in applied radiation protection.

8.4 AUTHORIZED USERS

The names and qualifications of Authorized Users (AUs) at the sites are not currently available. At a minimum, the Bull Hill Mine Manager and Upton Plant Site Manager will be AUs. An AU's primary responsibility is to ensure that radioactive materials are used safely and in accordance with regulatory requirements. The AU is also responsible for ensuring that procedures and engineering controls are used to keep occupational doses and doses to members of the public ALARA. AUs must have adequate and appropriate training to provide reasonable assurance that they will use licensed material safely, including maintaining security of, and access to, licensed material, and respond appropriately to events or accidents involving licensed material to prevent the spread of contamination. The qualifications of an AU will be consistent with those described in Section 8.7.2 of NUREG-1556, volume 12.

8.5 SAFETY AND ENVIRONMENTAL REVIEW PANEL

RER will establish a SERP, consisting of at least three members. One will be the RSO, a second with authority to implement managerial and financial changes (e.g., the Plant Manager), and a third with authority to make operational changes (e.g., the Plant Manager). The SERP may include others (e.g., RER employees or consultants) on a temporary or permanent basis whenever it requires additional technical or scientific expertise. At least one member of the SERP shall be designated as chairman.

The purpose of the SERP will be to evaluate, discuss, approve, and record any changes to any Standard Operating Procedure (SOP), the facility, or tests and experiments involving safety or the environment. The changes will not require a license amendment pursuant to 10 CFR 40.44 as long as the changes do not:

- Create a possibility of an accident unlike what is evaluated in the license application (as updated);
- Create a possibility of a malfunction of a structure, system, or control unlike what is evaluated in this license application (as updated); and
- Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report or the environmental assessment or technical evaluation reports or other analyses and evaluations for license amendments.

The SERP will compile records of its evaluations. These records will provide the basis for determining if the implementations of the changes do not require a license amendment pursuant to 10 CFR 40.44. Any change approved by the SERP will be documented in writing by showing the date of its implementation; and affected operating procedure, facility, and/or test and experiment before and after the change.

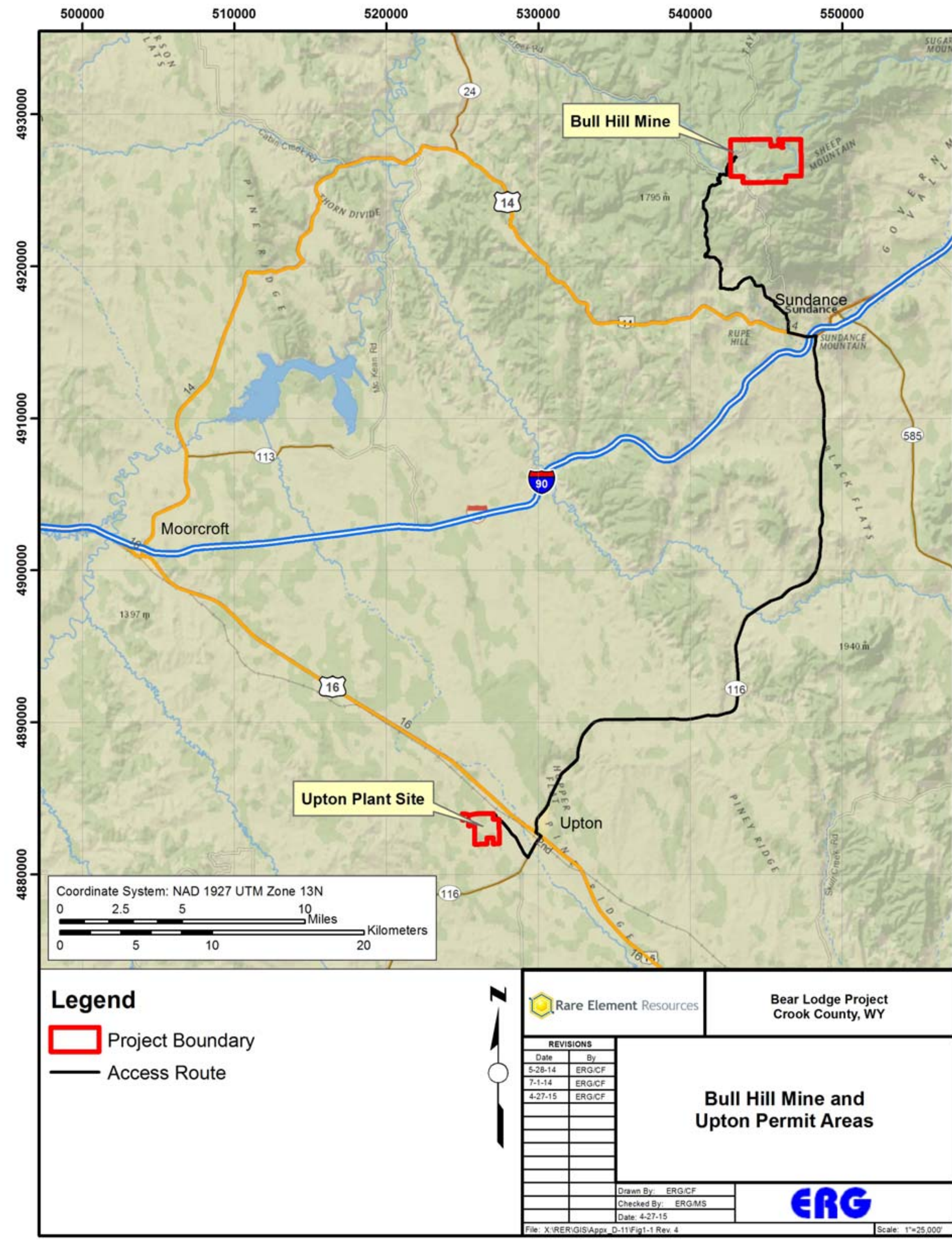
The SERP will have the authority to raise issues regarding the health and safety of workers, the general public, and/or the environment due to the operation of the facility to the Mine Manager and the Director of EHS.

The SERP will prepare an annual report, describing the actions it took, including changes to operating procedures, the facility, or tests and experiments that involve safety or the environment enacted since the previous report was issued. The report also will document the reason for each change, whether it required a license amendment, and the basis for its determination. This report will be included in the annual report described in Section 10-14.

9.0 FACILITIES AND EQUIPMENT

This section provides a description of the facilities and equipment for the Bear Lodge Project. The Bear Lodge Project consists of the Bull Hill Mine Site located approximately 12 miles (19.3 km) north of Sundance, Wyoming in central Crook County, Wyoming and the Upton Plant Site located 40 miles (64.4 km) south of the Bull Hill Mine Site, approximately 2 miles (3.2 km) northwest of the Town of Upton, Wyoming in north-central Weston County (see Map 9.0-1). The Bull Hill Mine consists of the Mineable Pit, Waste Rock Facility, PUG Plant and access road. Descriptions of the facilities and equipment used in this process are provided in Section 9.1.

The Upton Plant contains the Hydromet Plant and TSF. The Hydromet Plant is where further physical and chemical processing of the ore from the Bull Hill Mine will occur to produce a TREO product. Section 9.2 describes the Upton Plant processes, including its facilities and equipment.



Map 9.0-1
Bull Hill Mine and Upton Permit Areas

9.1 PHYSICAL UPGRADE PLANT

The PUG Plant, shown in Figure 9.1-1, will be located near the Bull Hill Mine. The PUG Plant is designed to use a combination of crushing, screening, and gravity separation, depending on the ore type being treated, to reduce the physical mass of the ore by reducing gangue and concentrating the rare earth-bearing fines for shipment to the Hydromet Plant. The Bull Hill deposit contains varying proportions of weathered high-grade oxide and oxide-carbonate ores, along with variable grades of stockwork mineralization adjacent to the higher-grade ores. Each of these ore types will have a different mass reduction and upgrade percentage in the PUG circuit. The process at the PUG will be conducted in two distinct phases described below.

9.1.1 PHASE I PROCESS

Phase I will consist of processing high grade oxide ore for the first 9 year period of operation. The high grade ore will be removed from a stockpile by a loader and screened through a 24 inch grizzly. The oversized material will be stockpiled as waste rock. The minus 24 inch material drops through a hopper to a jaw crusher. Secondary crushing, a cone and roll crusher will supplement the jaw crusher for harder ore when needed. The ore from the jaw crusher is then sized through a 3 inch screen and conveyed to a crushed ore stockpile. From the crushed or stockpile, the -3 inch ore is conveyed to a crushed ore storage bin where trucks are loaded to transport the ore to the Hydromet Plant for wet crushing and screening to -48 mesh size and ultimately fed to the Hydromet process. The detailed process flow diagram for Phase I of this process is provided in Appendix C-1. The PUG Phase I circuit is designed with the flexibility to process up to 1,600 tons per day of high grade oxide ores. The average Life of Mine (LOM) source material (uranium+thorium) content in the ore feeding the PUG Plant is 0.04 percent by weight. The average source material content in the -3 inch crushed ore is 0.055 percent by weight.

9.1.2 PHASE II PROCESS

Phase II of the PUG process is planned to occur after the first 9-year period to the end of mine life. The crushing process is similar to Phase I except the -3 inch ore will be reclaimed from the stockpile by two belt feeders and conveyed to a cone crusher (3/4 inch), operating in open circuit. Material is then passed through a 6 mesh roll crusher and sent to a 6 mesh wet screen. Oversized material is recycled back to the 6 mesh roll crusher while undersized slurry is sent to a 32 mesh screen. From this point forward, the PUG process is dependent on ore composition.

The PUG pre-concentrate thickener is used to recover water and increase slurry density to 50 percent w/w (weight basis) before filtering. The underflow will be pumped to the press filters to further decrease the pre-concentrate moisture to 16 percent on a dry weight basis. The pre-concentrate will be transported to the Hydromet Plant by truck. The detailed process flow diagram of Phase II of the PUG process is provided in Appendix C-1. The PUG Phase II circuit has been designed to process up to 1,600 tons per day of oxide carbonate (OxCa) and low grade ores and will produce up to 600 tons per day of rare earth carbonate pre-concentrate. The average source material (uranium+thorium) content in the pre-concentrate is 0.068 percent by weight.

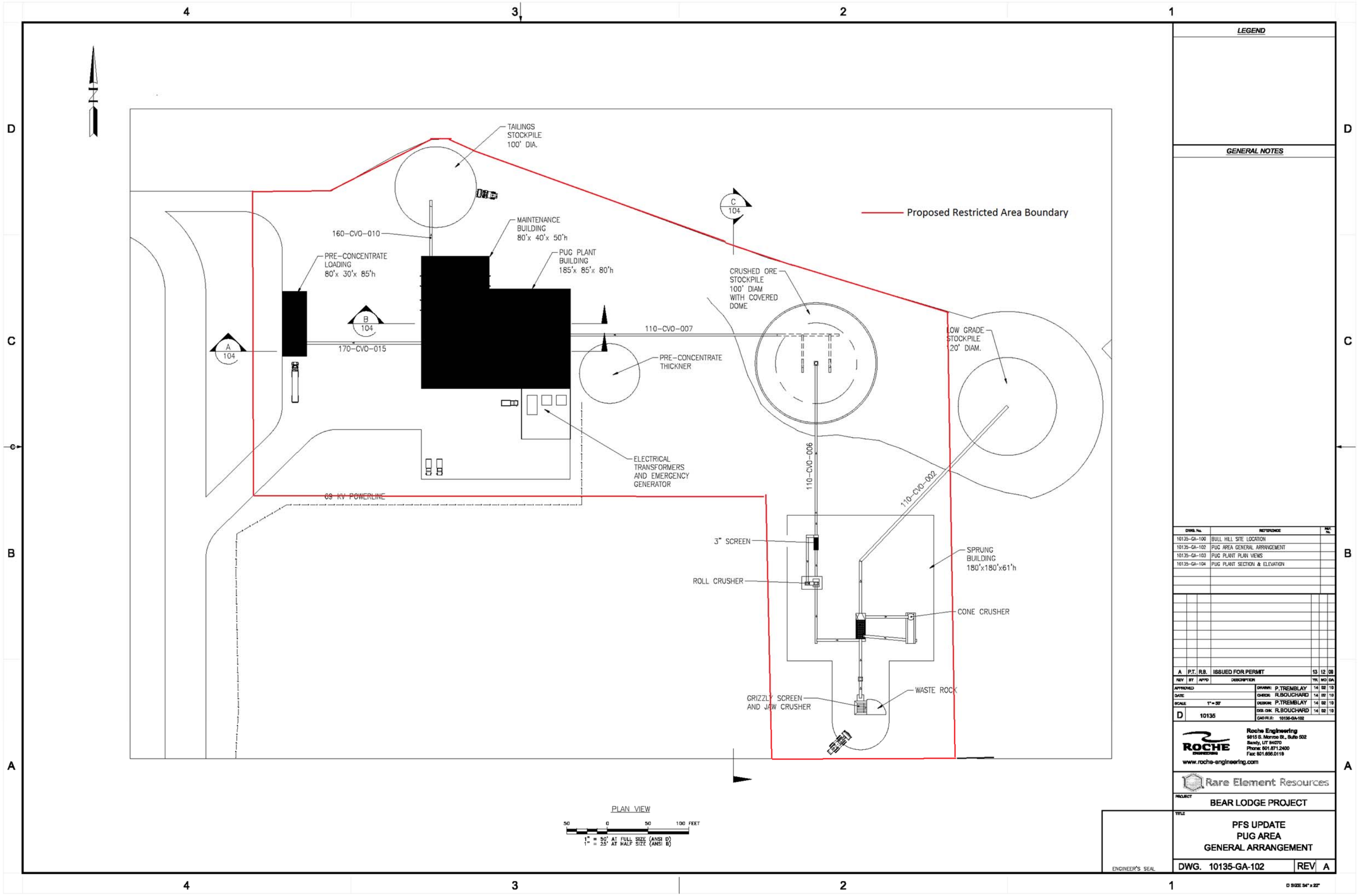


Figure 9.1-1
Physical Upgrade Plant Layout and Proposed Restricted Area

9.1.3 STRUCTURES

The following structures will be within the restricted area as shown on Figure 9.1-1.

Primary Crusher Building. The primary crusher buildings will host the jaw crusher, secondary crusher, and the coarse vibrating screen units. The primary crusher will be fed from the electrical room located in the PUG Plant building. The interior of the building will be a basic shell to house small portable types of equipment, with sufficient capacity to accommodate the expanded production rate in Year 10. Operating platforms will be completed using grating and handrails. The dimensions of the primary crusher building are 180 ft. x 180 ft. x 61 ft. high.

Main PUG Building. The main PUG building will host the administration area, showers and change room, laboratory, PUG maintenance room, and the process area (including control room and electrical room). The building is estimated at 185 ft. x 85 ft. x 80 ft. high). An annex of 80 ft. x 40 ft. x 50 ft. high, located on the north side of the building will host the maintenance shops.

The administration area will host the offices for administrative and technical personnel. It will be built on a single floor estimated at 40 ft. x 60 ft. (2,400 ft^2) and will be located on the southwest corner of the main building.

The showers and change room area will include lockers, change rooms, showers, and a lunchroom. It will be built on the second floor, estimated at 40 ft. x 40 ft. (1,600 ft^2), and will be located on the south side of the main PUG building.

The laboratory area will host all equipment required to analyze samples from the mining and processing as well as a sample storage area. The laboratory will be built on a single floor, estimated at 20 ft. x 40 ft. (800 ft^2), and located on the south side of the PUG building.

The interior of the process area will be built using multi-level steel platforms for operation and maintenance needs. The plant ground floor is designed to segregate the containment areas. Major equipment will be installed on independent steel platforms. The platforms will be completed using grating and handrails. A 20-ton overhead crane will be installed to support the maintenance operations. The proposed layout of the Main PUG Building is shown in Figure 9.1-2.

Pre-Concentrate Loading Building. The mineral pre-concentrate loading building will host the pre-concentrate loading bin and the truck load out system. A scale will be installed to control the amount of pre-concentrate loaded on trucks. The building is estimated at 80 ft. x 30 ft. x 85 ft. high. It will be built using multi-level steel platforms for ongoing operation and maintenance needs. Major equipment will be installed on independent steel platforms. The platforms will be completed using grating and handrails. A 2-ton monorail and hoist crane will be installed to support the maintenance operations. The proposed layout of the Pre-concentrate Loading Building is shown in Figure 9.1-2.

In addition to the structures describe above, the crushed ore stockpile will be covered by a 100 ft diameter dome structure.

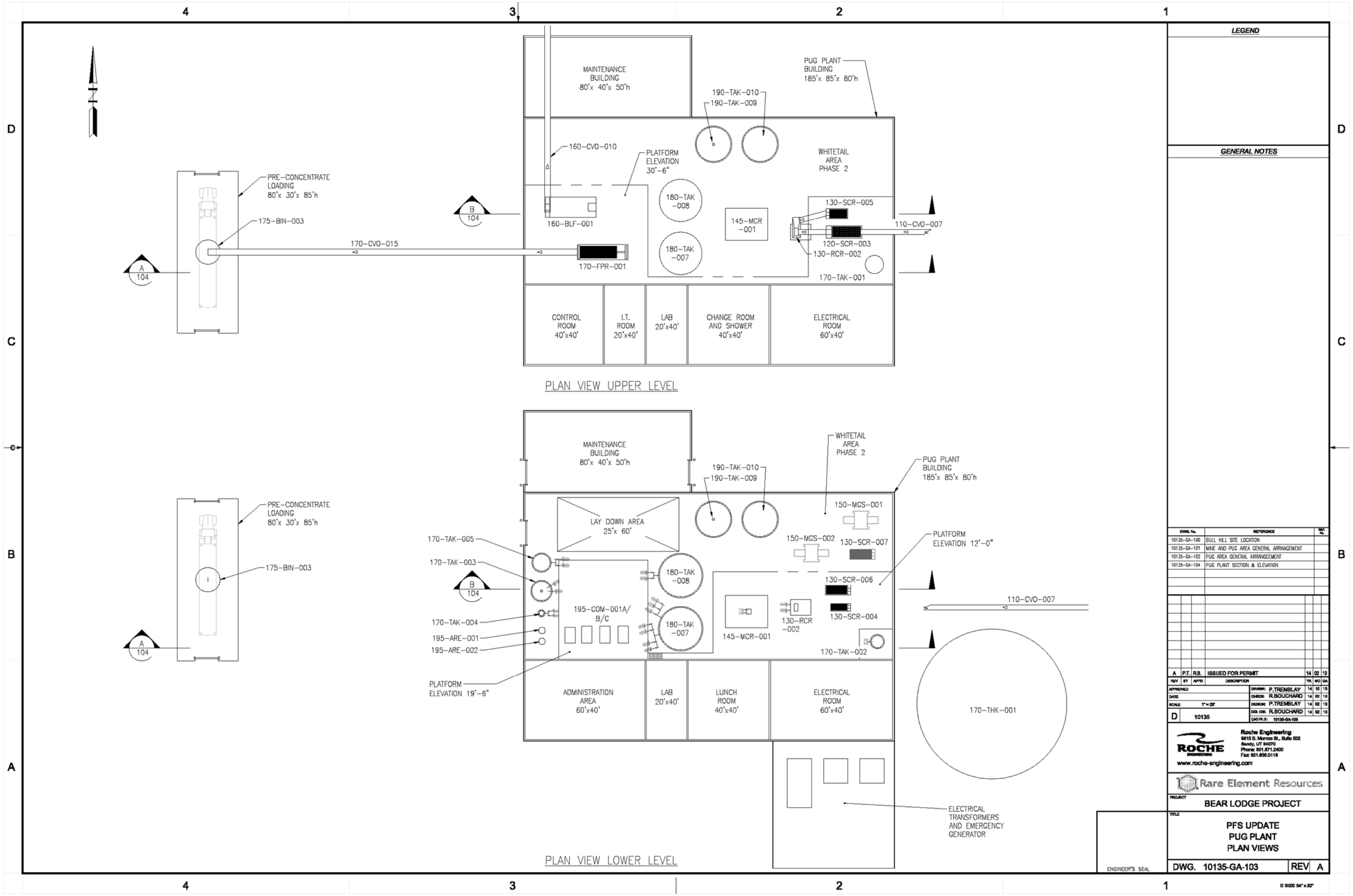


Figure 9.1-2

Figure 9.1-2 Layout of Main Physical Upgrade Building and Pre-Concentrate Loading Buidling

9.1.4 EMISSION CONTROL

Control of airborne emissions of radioactive particulates and gas at the PUG Plant will be accomplished by normal ventilation of buildings and the use of primarily wet processes to grind and classify the ore. Only water and a flocculent will be used in the PUG process. The wet processes will be contained mostly within the Main PUG building with the exception of the pre-concentrate thickener located outside of the southeast east corner building. Process controls, including level indicators and alarms will be used through the PUG process to prevent release of water. The pre-concentrate material also will have a moisture content of approximately 17 percent which also will help mitigate fugitive dust emissions.

The engineering controls to be used at the PUG Plant are as follows:

- Use of wet processes to grind and classify the ore to limit airborne emissions;
- Normal building ventilation to limit occupational exposure to radon and dust;
- Process controls, including level indicators and alarms for wet processes to limit releases; and
- Wet processes contained within the Main PUG building with secondary containment.

9.2 UPTON PLANT SITE

The Upton Plant Site is located in north-central Weston County, northeastern Wyoming. The property is located 2 road miles (3.2 km) northwest of the Town of Upton, Wyoming and approximately 40 miles (64.4 km) southwest of the town of Sundance, Wyoming. The Upton Site includes portions of Sections 28, 29, and 32 and all of Section 33, Township 48 North, Range 65 West (see Map 9.0-1).

The Upton Plant Site includes the Hydromet Plant and TSF. The REE mineral pre-concentrate and the -3 inch high grade ore will be transported by enclosed trailered truck from the Bull Hill Mine to the Hydromet Plant. The Hydromet process uses hydrochloric acid to leach the REE from the ore. Rare Earth Oxalates are then precipitated from the pregnant leach solution by the addition of oxalic acid and converted to rare earth oxide (REO) in a kiln. Thorium and other impurities are removed from the REO by a nitric acid leach and hydroxide precipitation carried out in several stages. Ammonium hydroxide is used for the hydroxide precipitation steps and produces an ammonium nitrate byproduct. The REE hydroxides are converted back to REO in a final dryer. Hydrochloric acid, and oxalic acid, is recovered and recirculated back into the process for a significant reduction in the cost of these reagents. The tailings from the Hydromet Plant will consist of the leach residue and solids produced from acid regeneration and once neutralized, will be disposed of at the WDEQ-Land Quality Division (LQD) permitted TSF located within the Upton Plant Site.

9.2.1 HYDROMET PROCESS DESCRIPTION

The Hydromet Plant is designed to process the pre-concentrate through acid leaching followed by the RER's proprietary recovery technology. This process uses a chloride solution to extract the REE into a liquid, then uses oxalate reagents to facilitate the selective precipitation of the REE. The benefits of this process are that it achieves a high-purity, near thorium-free, bulk TREO concentrate and has the ability to regenerate and recycle a majority of the water and reagents used in the process.

The -3 inch high grade ore will be further crushed and classified at the Upton Plant Site during the first 9 years of operation. The rare earth oxide production rate will vary based on the REE pre-concentrate production rate and grade. The rare earth element product will have an approximate rare earth equivalent content of 97 percent TREO. The uranium+thorium content of the TREO product averages 0.005 percent by weight.

Figure 9.2-1 shows a conceptual block process flow diagram of the Hydromet Plant and PUG Plant. The detailed process flow diagram Hydromet process is provided in Appendix C-2.

The Hydromet consists of two processes. The first part is primarily a direct acid digestion of minerals in chloride media at moderate temperature (113 - 194 ^{o}F). Between 97-99 percent of rare earths are digested and transferred into the pregnant leach solution (PLS). Subsequently, the rare earths are selectively precipitated from the PLS by means of an oxalate reagent. All the un- precipitated metals, such as iron, manganese, magnesium, calcium, aluminum, zinc, potassium, barium and traces of uranium etc. remain in the barren leach solution (LS). At this point, between 95 and 99 percent of the rare earth elements are selectively transferred to the oxalate precipitate solids as is thorium. The oxalates are subsequently recycled and stored separately. The acidic effluent solution or barren LS, full of base metals, is transferred to storage tanks next to the distillation column.

Because the Hydromet Plant is designed to be a zero-effluent process, the barren LS is subjected to distillation to capture free acid and water, leaving behind a residual liquor to be neutralized with an alkaline solution. The metals in the residual liquor are precipitated as carbonates (average source material content of 0.02% by weight), which will be co-mingled with leach residual solids plus alkaline media for neutralization to produce a paste for dry-stacking at the TSF. The source material content of the tails paste averages 0.023 percent by weight. The recovered hydrochloric acid and water are reused in the hydrometallurgical process mainly at the leach and dewatering stages.

The second part of the process is to remove thorium from the rare earth oxalates. There are two main components to this process: 1) selective precipitation of thorium as a hydroxide and 2) final precipitation of all the rare earths as hydroxides. It is necessary to convert the oxalates to oxides using a kiln, prior to removing thorium from the rare earth oxalates. The rare earth oxides are dissolved in nitric acid to enable downstream thorium precipitation as thorium hydroxide using a 20 percent solution of ammonium hydroxide. The thorium hydroxide averages 42 percent by weight natural thorium. The thorium-free nitrate solution then is transferred to another precipitation circuit where the rare earths are finally recovered as hydroxides and then calcined (or dried) to produce the final REO powder concentrate (>99 percent pure). The filtrate solution at this point contains ammonium nitrate which may be recovered as a valuable by-product and the water fraction is recycled back to alkaline and acid preparation steps.

Radionuclides in the uranium-238 and thorium 232 decay series are extracted efficiently from the initial feed ore and transferred to the PLS. Subsequently, thorium is sequestered from the PLS together with REEs and transferred to oxalate solids in a proprietary process. Other radionuclides are not transferred to the oxalates and remain in the barren PLS to be neutralized together with all base metal impurities. These base metal impurities and other radionuclides are co-mingled with leach residual solids plus alkaline media to produce a tailings paste for dry-stacking at the TSF. The thorium hydroxide material will be containerized and shipped off-site for disposal at a licensed third party facility.

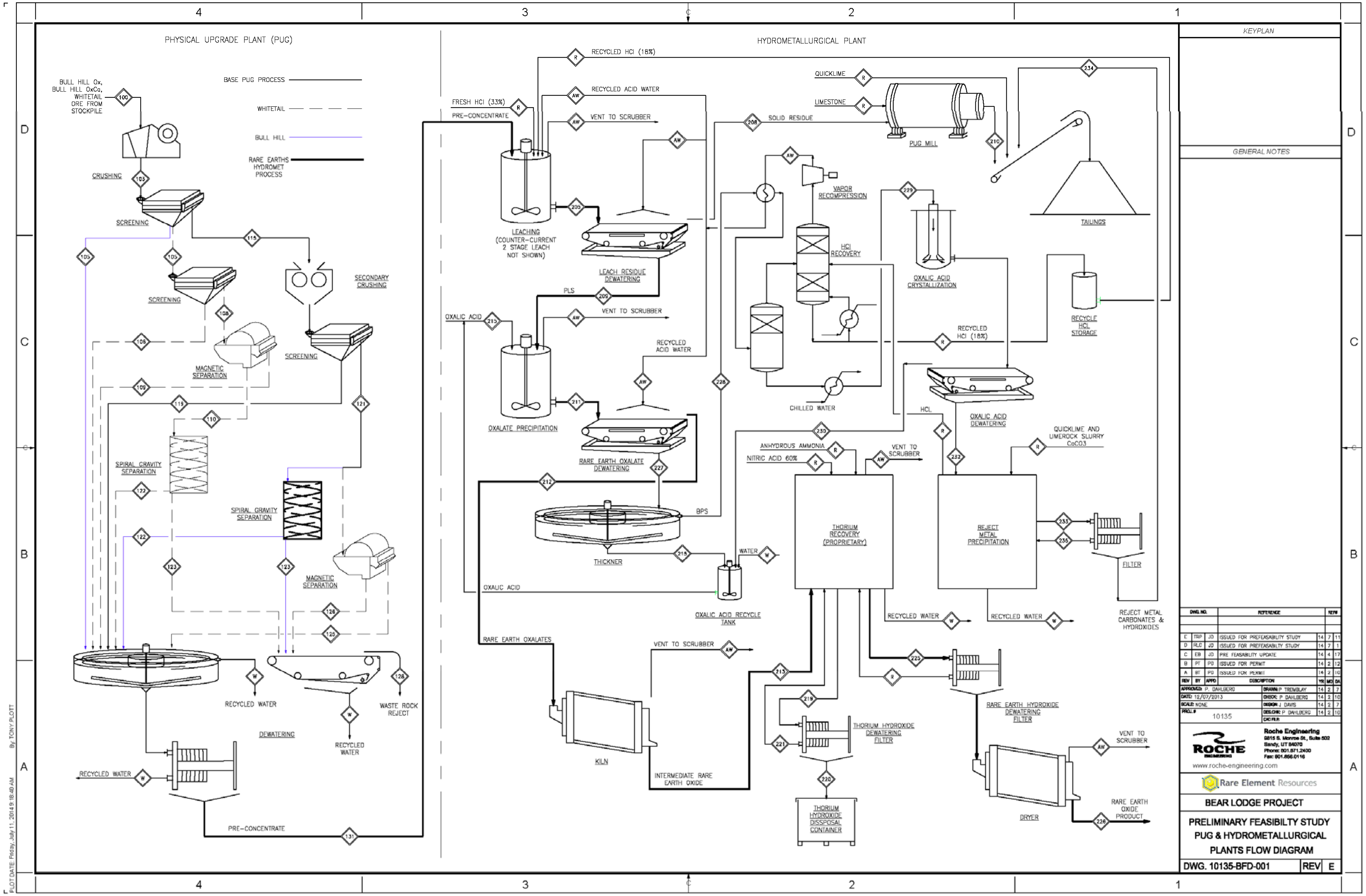


Figure 9.2-1

Figure 9.2-1 Generalized Process Flow for Hydromet and PUG Facilities

9.2.2 TAILING STORAGE FACILITY PROCESS DESCRIPTION

The TSF is located west of the Hydromet Plant as shown on Map 9.2-1. The TSF is designed to meet the rules and regulations of the WDEQ-LQD, Chapter 3, Section 2(h)(i) Noncoal Mine Environmental Protection Performance Standards. The TSF will operate as a dry stack facility and, in general, activities there will consist of tailings transport, deposition, and management; embankment and liner construction; ongoing maintenance; and reclamation. The tailings material is a semi-dry paste, consisting of about 15 percent moisture.

The tailings from the Hydromet Plant will be transported to the TSF using haul trucks. Waste blending and neutralization of the waste streams (solids from leaching and precipitated metal carbonates) will occur at the Hydromet Plant prior to transport to the TSF. Active disposal areas and reclamation of completed areas within the TSF will be accessed by a network of haul roads established within and around the TSF footprint. Tailings will be end-dumped and spread with a dozer. Compaction of the waste will occur through material settlement as well as truck and dozer traffic associated with waste placement.

The TSF will be developed progressively, beginning at the north end of the facility and expanding southward. The main TSF embankment along the eastern, north, and south abutment berms will buttress the waste for long-term stability and control contact water within the TSF areal limits. The TSF liner system will be expanded in a manner to create a continuous liner system in the TSF as it expands both vertically and laterally. Intermediate berms will be constructed along the southern and western limits of each stage of liner construction to facilitate liner connection, TSF expansions, provide toe support to the waste slope during placement of the waste, and minimize surface water run-on into the active TSF area from the area between the active area and the surface-water diversion ditch.

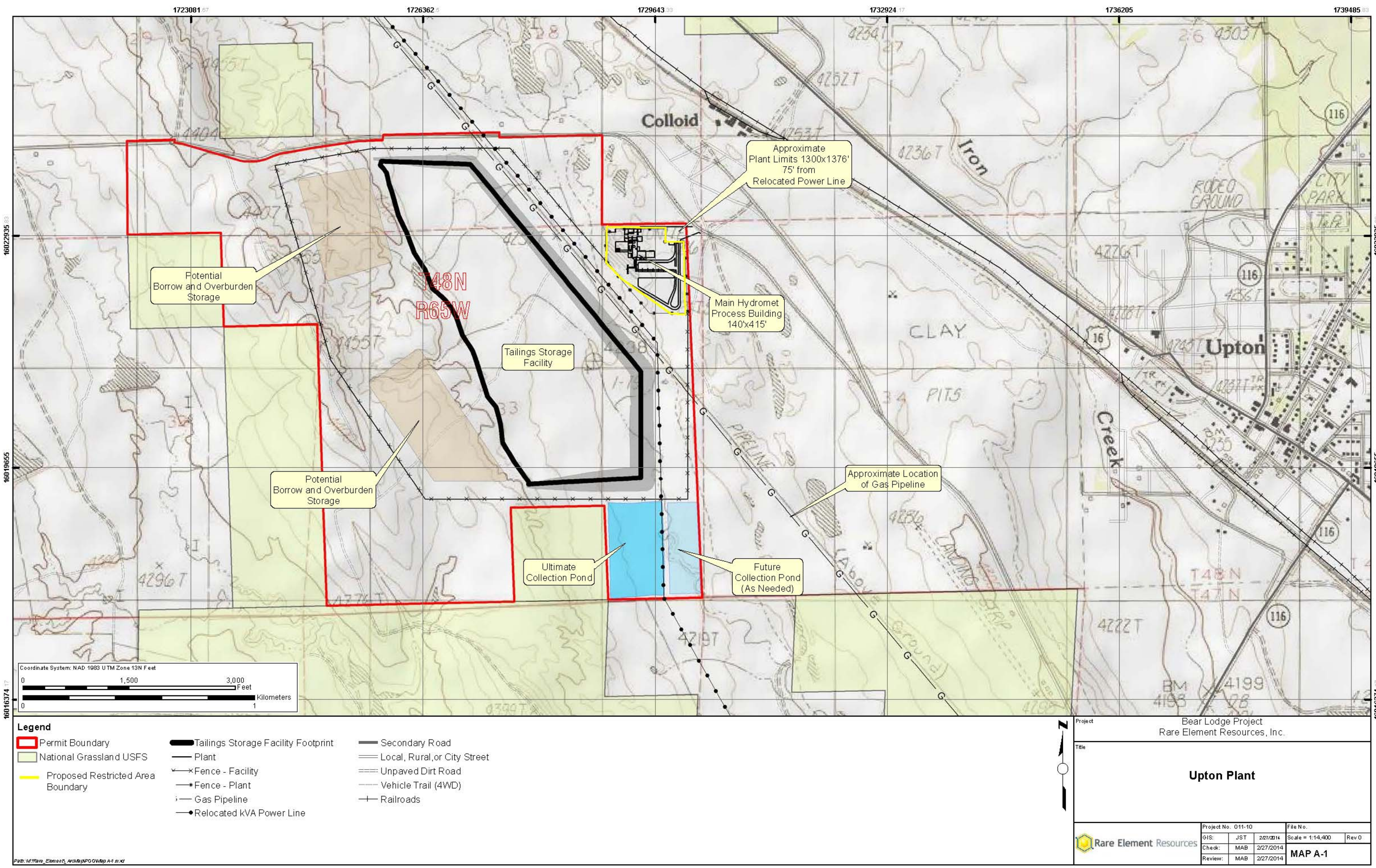
A 2- to 3-foot thick protective layer of crushed material will be constructed immediately over the geomembrane to protect the liner against damage, prior to the placement of waste. No equipment will access the geomembrane liner directly and low ground pressure equipment will be used to place the protective cover material. The thickness of the operations layer soil in that traffic path will be increased by an additional 3 feet of material capable of supporting the vehicular loads, should high ground pressure equipment be required to traverse over the operations layer prior to coverage with waste.

Contact surface water runoff from active areas of the TSF will drain to collection pond(s) constructed down gradient of the active area and within the TSF footprint. The movement of sediment from the active areas of the TSF will be controlled as appropriate with silt fences or other best management practices. The collection pond will be the final means to manage erosion from the active area of the TSF.

RER, as part of this license application, is applying for a regulatory exemption of the TSF and its wastes as licensed material because the planned source material content of the tailing paste is an average of 0.023 percent by weight, less than the 0.05 percent by weight exemption as unimportant quantities of source material contained in 10 CFR 40.13(a). This is further discussed in Section 11.0.

9.2.3 BUILDINGS AND STRUCTURES

The following structures will be within the Upton Plant Site restricted area as shown on Figure 9.2-2.



Map 9.2-1
Upton Plant

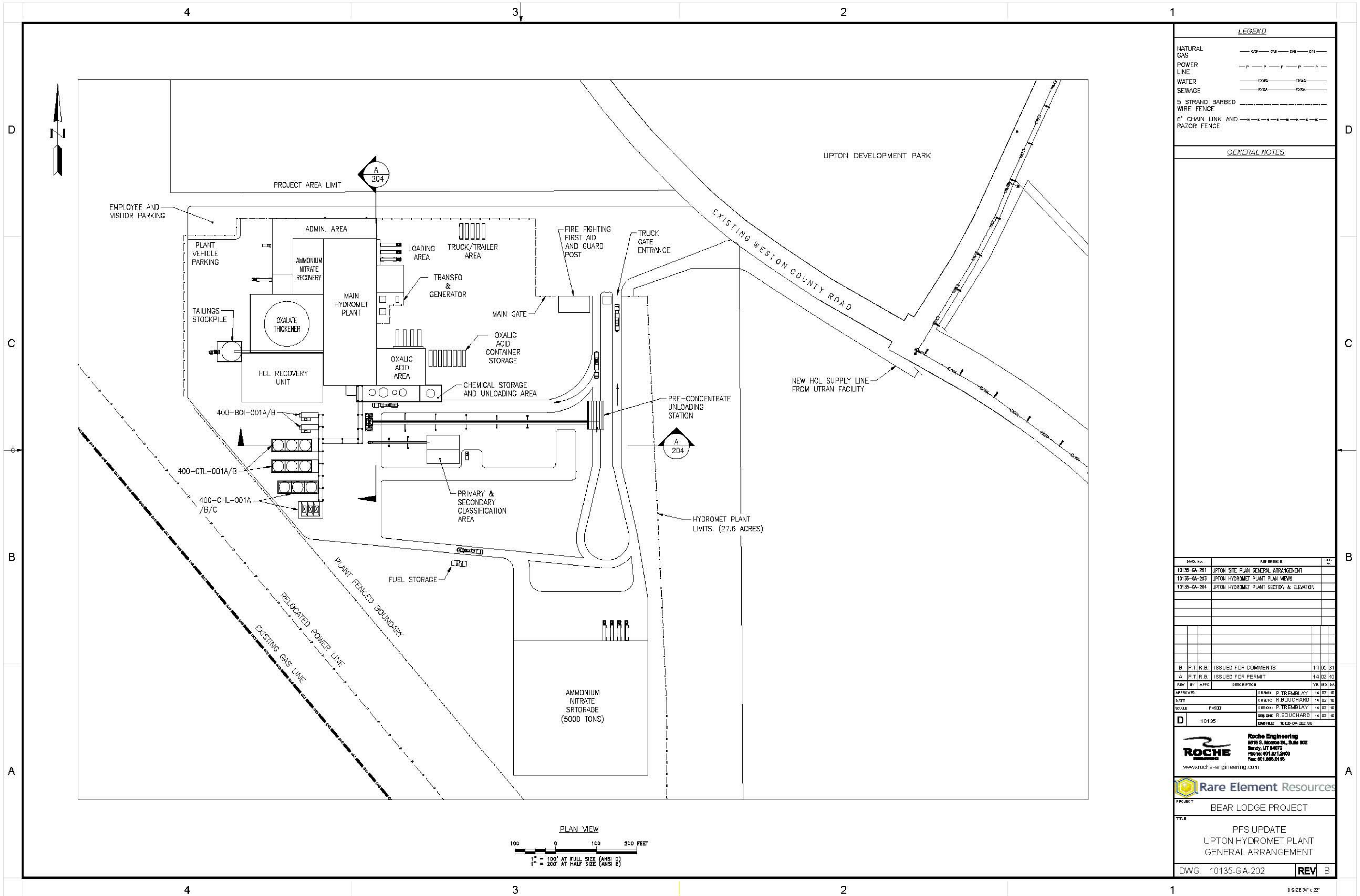


Figure 9.2-2
General layout of the Hydrometallurgical Plant

9.2.3.1 Security Office, Firefighting, and First Aid Building

The security office, firefighting, and first aid building will be a pre-engineered structure complete with insulted steel roof deck and steel wall cladding. The building will be divided in two sections. The first section will be used as a security office and will have a safety training room. The second section will be used as the firefighting and ambulance base, and will include a first aid center.

9.2.3.2 Main Hydromet Building

The main Hydromet building will be divided into areas for administration, shower and change room, analytical laboratory, light vehicle maintenance, workshop and storage, and the Hydromet process area. Concrete masonry block walls will be built between each area.

The administration area will host the offices for administrative and technical personnel, as well as the lunch room for employees.

The shower and change room area will include lockers, change rooms, and shower areas. The laboratory area will host the equipment required to analyze process samples as well as environmental samples. A sample storage area will also be provided.

The light vehicle maintenance, workshop, and storage area will include a truck shop to perform maintenance on vehicles, a workshop to perform maintenance on the various process equipment and instruments of the facility, and a spare parts storage area.

The main Hydromet building will host the process unit operations, the mechanical and electrical room, and the control room. The interior of the Hydromet building will be built using multi-levels of steel platforms for ongoing operation and maintenance needs. The plant grading is designed to isolate each area within its concrete containment. Major equipment will be installed on independent steel platforms. The platforms will be completed using grating, handrails, and kick plates as required by Mine Safety and Health Administration (MSHA) regulations.

In addition to the buildings, an outdoor laydown area will be built to receive and store large pieces of equipment and bulk supplies.

9.2.3.3 Pre-concentrate Handling Structure

The pre-concentrate handling system is composed of an access road, an unloading station, two storage silos, and one feed conveyor. The pre-concentrate trucks will use their own gate to reach the pre-concentrate unloading station, located on the southeast corner of the Hydromet Plant. The trucks will discharge their load in an enclosed building to an underground hopper. A conveyor will transport the pre-concentrate from the discharge hopper to the storage silos. The Hydromet Plant feed will be provided by one conveyor fed from the storage silos. Trucks from the Bull Hill Mine Site will access the Pre-concentrate Handling Structure without having to enter the Upton restricted area.

9.2.4 EMISSION CONTROL

The Hydromet Plant is designed to be a zero emission facility. As such, air containing the vapor and gaseous emissions from the process is passed through a scrubber prior to being released to the atmosphere. Processes generating particulates such drying thorium hydroxide and the rare earth product are also ventilated through a scrubber prior to air being released to the atmosphere. The scrubbers supporting various processes in the Hydromet Plant are shown in the detailed process flow diagrams in Appendix C-2. Table 9.2-1 lists the scrubbers to be used at the Hydromet Plant and the processes they support. Stacks associated with scrubbers will be monitored for radioactive gaseous and particulate releases as appropriate.

To mitigate potential liquid releases from tanks and processes, the Hydromet facility is designed such that every building and its equipment is contained, and any run-off material will be collected in a sump, and disposed of properly.

Table 9.2-1
Summary of air emission controls for the Hydromet

Equipment ID	Description	Treatment Stream
200-BGH-001	Pre-concentrate Discharge Chute Baghouse	Dust collection from Pre-concentrate Silo discharge
300-SCR-001	Screw Dryer Scrubber	Vent from screw dryer in rare earth oxalate process
300-SCR-002	Kiln Effluent Gas Scrubber	Vent from Kiln in rare earth oxalate process
500-SCR-001	Caustic Scrubber	• Off gas from leach reactors condensers • Off gas from leach area vents • Vent from Distillation Column • Vent from recycled HCL surge tank • Vent from acid water storage tank • Vent from ammonia storage tank • Vent from oxalate reactors condenser
600-SCR-001	Ventilation Scrubber	• Vent from thorium precipitation reactor • Vent from rare earth hydroxide precipitation reactor • Water vapor from calcium chloride screw dryer • Water vapor from rare earth screw dry • Water vapor from rare earth nitrate reactors

Engineering controls at the Hydromet Plant will be as follows:

- Scrubbers and baghouses will be used to mitigate gaseous and particulate air emissions.
- The Hydromet Plant is designed such that every building and its equipment is contained, and any run-off material will be collected in a sump.
- Process controls, including level indicators and alarms, will be used for wet processes to limit releases.
- Gaseous and particulate emission of radionuclides will be monitored at stacks and the cooling tower.

10.0 RADIATION SAFETY PROGRAM

The Radiation Safety Program (RSP) will be 1) designed in accordance with the requirements of 10 CFR 20 Subpart B and 2) include limiting potential radiological doses to workers and the public at each of the RER facilities (PUG, Hydromet, and TSF) to levels that (at minimum) comply with the requirements of 10 CFR 20 Subparts C and D, and that further reduce this dose potential to levels that are ALARA below these regulatory limits per respective requirements of 10 CFR 20.1101(b)(d). The elements forming the framework of the RSP include:

- ALARA Program
- Inspections and Audits
- Training
- Radiological Surveys/Monitoring
- Minimization of Contamination
- Radiation Work Permits
- Posting Program
- Occupational Dose Monitoring
- Public Dose Monitoring
- Material Receipt and Accountability
- Transport of Licensed Material
- Operating and Emergency Procedures
- Maintenance
- Recordkeeping
- Reporting

Summaries of each RSP element are provided below.

10.1 ALARA PROGRAM

ALARA policy statement:

> RER will support, maintain, and enforce a company policy of keeping radiological doses to site workers and the public as far below applicable regulatory limits as is reasonably achievable, taking into account the state of technology, economics of improvements in relation to the state of technology; and economics of improvements in relation to benefits to public health and safety and the recovery of rare earth minerals for use in technologies important to the public interest.

Implementation of this ALARA policy will be a formal component of the RSP based on the requirements of 10 CFR 20.1101(b)(d), along with the fundamental principles and practices as recommended in NRC Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable* (NRC, 1975). RER management will support the company's ALARA program, monitor its performance via related information and assessments as provided by the RSO, and advocate improvements where reasonably achievable, based on recommendations of the RSO and by third party ALARA program audits.

Specific elements of the ALARA program will include:

1) Informing all workers and site personnel of the company's ALARA policy/program.

2) Continual internal monitoring and evaluation of the effectiveness of the RSP and ALARA programs by the RSO and radiation protection staff, including assessments of ways to further reduce exposures.
3) Assignment of well-defined responsibilities for implementation of elements of the RSP by properly trained staff.
4) Appropriate training and instruction as commensurate with the potential for radiological exposures for all site workers and visitors. Topics will include, as appropriate, radiation science, radiological hazards at the facility, radiation protection principles, and adherence to provisions of the RSP including compliance with related regulations and all radiation safety work rules.
5) The RSO will have the authority to enforce safe facility operations, including halting any operation deemed to be unsafe.
6) Modifications to operations and maintenance procedures, along with equipment and facilities, will be made where this will substantially reduce radiological exposures at reasonable cost.

10.2 INSPECTIONS AND AUDITS

The RSO and radiation protection staff will monitor the proper implementation of the RSP and adherence to the ALARA policy via routine and non-routine inspections. The RSO will monitor the effectiveness of the RSP based on review of inspection reports and data from facility radiation surveys and monitoring and worker dose monitoring. The objective of program inspections and data reviews is to ensure consistent program performance and to identify and correct any deficiencies expeditiously. The RSO will document any program modifications due to deficiencies/corrective actions ALARA-based improvements.

A third party audit will be conducted annually by an independent organization, the auditor(s) for which will have qualifications that are similar to those of the RSO. The auditor (s) will be experienced in the operational aspects of radiation protection practices specific to the licensed activities at the facilities. The RSO will not be an auditor but will facilitate the audit and provide needed information.

In accordance with 10 CFR 20.1101(c), the objectives of the third party audit program will be to evaluate: 1) efforts to maintain doses ALARA; 2) compliance with NRC and DOT regulations and license conditions; 3) the ability to identify and correct deficiencies in the RSP; 4) overall management of the RSP including senior management's role and commitment; 5) implementation of the monitoring program, and 6) whether operating procedures which can potentially affect the use of radiative materials or occupational dose have been developed, documented, implemented, and maintained to demonstrate compliance with 10 CFR 20.1101(a).

A written report of the annual RSP audit will be sent to the Director, Environmental Health and Safety. At a minimum, the reports will summarize the following information:

- Organization and scope of program audited, will describe:
  - the organizational structure, noting any changes in personnel;
  - the scope of licensed activities at the audited location; and
  - check whether the RSO is the person identified in the license and fulfills the duties specified in the license.
- Training, retraining, and instruction to workers, will describe:
  - compliance with 10 CFR 19.12;

    - adequacy of radiation safety training given to employees who work with licensed materials;
    - employees have read and understood the RSP, and have been provided copies of applicable operating and emergency procedures;
    - refresher training performed; and
    - by interview or observation of selected workers, if the workers can properly implement the procedures.
- Facilities, will describe:
    - verification that the facilities are as described in the license documents;
    - the location of permanent field offices and/or temporary job sites and if these sites were visited in the audit; and
    - if a site was not visited during the audit, and an explanation as to why.
- Material, will document:
    - that the license authorizes the quantities and types of byproduct material that the licensee possesses and uses. This portion of the audit will also document that inventories are conducted at least every six months.
- Employee exposure records (external and internal)
- Bioassay results, if any
- Inspection log entries and summary reports of routine and non-routine inspections
- Documented training program activities
- Radiation safety meeting reports
- Radiological survey and sampling data
- Reports on overexposure of workers submitted to the NRC
- Operating procedures that were reviewed during the time period
- Compliance with applicable regulations and license conditions
- Review of findings of prior audits and their resolution

Finally, the reports will include the following:

- An evaluation of trends in personnel exposures for identifiable categories of workers and types of operational activities;
- Assessment of whether the equipment used to control exposures is being properly used, maintained, and inspected; and
- Recommendations on ways to further reduce personnel exposures from natural uranium and thorium and their progeny.

10.3 TRAINING

A description of the radiation safety training program is provided below.

10.3.1 INITIAL TRAINING

Workers or individuals frequenting or working within restricted areas will be instructed by means of a formal, documented training class in the inherent risks of exposure to radiation and the fundamentals of protection against exposure to natural uranium and thorium and their associated decay products before beginning work at the site. Additional guidance to be provided to trainees and reviewed within the training material as appropriate is found in NRC Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure* (NRC, 1987), and NRC Regulatory Guide 8.29, *Instruction Concerning Risks from Occupational Radiation Exposure* (NRC, 1981).

The course of instruction will include the following topics:

- Radiation Safety;
- Radiological and toxic hazards of exposure to natural uranium and thorium and their progeny (biological effects);
- How natural uranium and thorium and their progeny enter the body (inhalation, ingestion, and skin penetration);
- Why exposures to ionizing radiation should be kept ALARA;
- Methods to mitigate internal and external exposure to ionizing radiation;
- Personal Hygiene;
- Proper wearing protective clothing and its associated risk;
- Using respirators correctly and their associated risk;
- Administrative rules to mitigate work dose such as eating, drinking, and smoking only in designated areas;
- Using proper methods for decontamination (for example, showers);
- Facility-Provided Protection;
- Ventilation systems and effluent controls;
- Cleanliness of the work place;
- Features designed for radiation safety for process equipment;
- Standard operating procedures specific to trainee’s job function;
- Security and access control to designated areas;
- Health Protection Measurements;
- Measurement of airborne radioactive materials;
- Bioassays to detect radionuclides;
- Surveys to detect contamination of personnel and equipment;
- Personnel dosimetry;
- Radiation Protection Regulations;
- Regulatory authority of NRC in Wyoming;
- Authority of RSO;
- Material control and accountability;
- Employee rights in 10 CFR 19;
- Radiation protection requirements in 10 CFR 20;
- Audit program; and
- Emergency/contingency plans.

A written or oral test will be given to each worker, with questions directly relevant to the principles of radiation safety and health protection at the site and as covered in the training course. The instructor will review the test results with each worker. The instructor will discuss any wrong answers to test questions with the worker until he or she understands the correct answer. Workers who fail the test (achieve a score below 70 percent) will be retested after receiving additional training. Tests and results will be maintained on site.

10.3.2 REFRESHER TRAINING

Workers or individuals frequenting restricted areas will be provided an abbreviated refresher training course annually or whenever there is a significant change in duties, process, regulations, or the terms of the radioactive materials license. A written or oral test, with questions directly relevant to the principles of radiation safety and health protection at the site and as covered in the training course, will be given to each worker. The instructor will review the test results with each worker. The instructor will discuss any wrong answers to test questions with the worker until he or she understands the correct answer. Workers who fail the test (achieve a score below 70 percent) will be retested after receiving additional training. Tests and results will be maintained on site. Retraining will include relevant information that has become available during the past year, a review of safety problems that have arisen during the year, changes in regulations and license conditions, exposure trends, and other current topics.

10.3.3 TASK-SPECIFIC TRAINING

Workers or individuals involved with licensed material or activities as a part of their job will receive task-specific training. Task-specific information may include:

- Authorized users and supervised users;
- Worker specific process tasks;
- Shipping of radioactive material;
- Applicable regulations and license conditions;
- Areas where radioactive material is used and stored;
- Appropriate response to spills, emergencies or other unsafe conditions;
- Emergency procedures;
- Survey programs;
- Waste management; and
- Instrumentation.

10.3.4 TRAINER QUALIFICATIONS

Radiation training, both initial and refresher, will be performed by the RSO or by someone with similar qualifications and expertise.

10.4 RADIOLOGICAL SURVEYS/MONITORING

Radiological surveys and monitoring will be important components of the RSP, in accordance with the requirements of 10 CFR 20 Subpart F. RER will survey all facilities and maintain contamination levels in accordance with the survey frequencies and contamination levels published in Appendix P to NUREG-1556, Vol. 12. This program will include the following elements:

10.4.1.1 Workplace/Occupational Surveys and Monitoring

- Routine surveys of facility work areas, including: 1) indoor/outdoor gamma radiation surveys, 2) scanning for fixed plus removable alpha and/or beta contamination, and 3) swipe tests and counting for removable alpha/beta contamination.
- Periodic monitoring of airborne particulate radionuclide concentrations in select indoor/outdoor work areas to verify compliance with 10 CFR 20 Appendix B effluent concentrations; and targeted air particulate monitoring as appropriate for activities requiring Radiation Work Permits (RWPs).
- Periodic breathing zone (BZ) air monitoring for workers performing routine activities; and targeted BZ air monitoring as appropriate for activities requiring RWPs.
- Routine monitoring of indoor radon and thoron air concentrations at select indoor/outdoor locations at the facilities.
- Personal external dosimeter monitoring program for site workers.

10.4.1.2 Effluent and Site Boundary Monitoring

- Periodic monitoring of effluents in air (radon, thoron, and radioactive particulates) from exhaust stacks at the facilities.

10.4.1.3 Contamination Surveys

- Routine surveys of work areas, including: 1) indoor/outdoor gamma radiation surveys, 2) scanning for fixed plus removable alpha and/or beta contamination (the latter including alpha/beta swipe tests, here and in all cases below) and 3) swipe tests and counting for removable alpha/beta contamination.
- Routine fixed/removable alpha/beta personal surveys for all personnel leaving restricted areas.
- Routine fixed/removable surveys for all equipment and vehicles being released from restricted areas.
- Gamma and fixed/removable surveys, as applicable and in accordance with 10 CFR 20.1906 for receipt and handling of packages containing radioactive materials.
- Gamma and fixed/removable surveys for offsite waste disposal shipments per applicable regulations (10 CFR 71; 49 CFR 173 Subpart I).

10.4.1.4 Survey/Monitoring Instrumentation

The following instruments, or their equivalents, will be used for the radiological survey/monitoring program:

- Personal external dose monitoring: thermoluminescent dosimeters (TLDs) or optically stimulated luminescent (OSL) dosimeters from a National Voluntary Laboratory Accreditation (NVLAP)-approved provider.
- General area gamma radiation surveys: Ludlum 44-10 sodium iodide detector with exposure rate readout meter (e.g., Ludlum 2350-1 or other appropriate rate meter), Ludlum 19 microR meter; and area monitors such as a Ludlum 375 sited where potential radiation areas may develop (e.g., thorium hydroxide storage area).
- Surveys of packages and/or waste material containers: Ludlum 19 microR meter, Ludlum 43-5 (alpha scintillator), Ludlum 44-9 (pancake Geiger Mueller - GM detector), Ludlum 43-93 (alpha scintillator with thick plastic beta scintillation material) and an appropriate rate meter for each; e.g., Ludlum Models 12, 2241, or 2224.
- Personnel and facility contamination measurements: Ludlum 43-93, Ludlum 44-9, Ludlum 44-40 (shielded GM detector), Ludlum 44-10, Ludlum 19 microR meter and an appropriate rate meter as described above.
- Air sampling measurements: MSA Elf lapel and/or other low volume area air samplers; e.g., the Model DF-14M cart-mounted air sampler from F&J Specialty Products.
- Radon/thoron monitoring: Passive integrating Landauer Rad-Track alpha track etch detectors (with/without thoron barrier membranes), real-time Durridge Rad 7 electrostatic collection/alpha-spectroscopy monitors

Instruments that meet the radiation monitoring instrument specifications published in Appendix K to NUREG-1556, Vol. 12 will be used. RER reserves the right to upgrade or use substitute survey instruments as appropriate.

10.5 MINIMIZATION OF CONTAMINATION

In accordance with the requirements of 10 CFR 20.1406 and 20.1701, Sections 9.1.4 (PUG Plant Emission Control), 9.2.1 (Hydromet Plant Process Description), 9.2.2 (Tailing Storage Facility Process Description), and 9.2.4 (Hydromet Plant Emission Control) provide detailed descriptions of how the facility design, processes, and operational procedures will minimize contamination of the facility and potential releases of contaminants to the environment. The primary engineering controls that comprise the design to control contamination are summarized as follows:

- The PUG Plant is designed to control airborne emissions (gas and fugitive dust) through the use of a largely enclosed, wet process to grind and classify ore, along with standard ventilation methods within the buildings. Process controls and alarm systems will be used to prevent or mitigate releases of water.
- The Hydromet Plant is designed to be a zero-effluent process using a combination of process containment within enclosed buildings and scrubbers to remove airborne gaseous and particulate radionuclides and other contaminants from stack emissions. Monitoring of contaminants in stack emissions will be performed as appropriate. Liquid releases to the environment will be prevented through process containment and a drainage/sump collection system.

10.6 RADIATION WORK PERMITS

A written RWP will be prepared, under the supervision of the RSO, for any non-routine activity for which no operating procedure exists and where there is the potential for exposure to radioactive materials above any control limit. The RWP will describe the following:

- Scope of the task to be performed;
- Potential radiological and physical hazards that may be encountered;
- Precautions necessary to maintain radiation exposures ALARA;
- Any radiological surveys, monitoring, or sampling necessary;
- Any appropriate task-specific training;
- Appropriate personal protective equipment (PPE) for the task;
- Documentation of any survey, monitoring, or sampling results; and
- Identification of personnel who will perform the task.

Examples of tasks that may require a RWP include:

- Maintenance on equipment (e.g., pumps and piping) in the vicinity of unshielded sources of unusually high gamma radiation emissions.
- Maintenance on airborne effluent scrubbers, bag houses, or other pollution control equipment which may contain radioactive material.
- Other work as may be directed by the RSO to ensure that doses are kept ALARA.

The RSO (or designated/qualified alternate radiation safety staff member) will review, approve, and sign the RWP before the start of the task. Any facility worker may identify the need for an RWP, but it will be prepared by qualified radiation safety staff for review and approval by the RSO.

10.7 POSTING PROGRAM

All entrances to the restricted area will be posted conspicuously with standard yellow and magenta signs including the words “ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL,” to provide general compliance with 10 CFR 20.1902(e). Some areas within the restricted area, e.g., thorium hydroxide handling or containerized storage areas, may need to be posted as “airborne radioactivity areas” or “radiation areas” as defined in 10 CFR 20.1003 and as required by 10 CFR 20.1902. Routine radiological surveys and measurements as described in Section 10.3 will determine if these special postings are required.

10.8 OCCUPATIONAL DOSE MONITORING

10.8.1 EXTERNAL DOSE

RER employees that routinely work within restricted areas will be subject to an external occupational dosimetry program, consistent with guidance on occupational dose monitoring in NUREG-1556, Vol. 12. Occupational dose will be measured using either TLDs or OSL dosimeters from an NVLAP-approved provider. Results will be combined with calculated estimates of internal doses (described below) to obtain the annual, total effective dose equivalent (TEDE) for each worker for demonstration of compliance with applicable dose limits in 10 CFR 20.

10.8.2 INTERNAL DOSE

Monitoring of internal doses will be based primarily on air sampling (ingestion intakes will essentially be eliminated by strict employee adherence to all radiation safety work rules). General area air samplers and/or BZ samplers will be used as appropriate to measure radionuclide concentrations in air particulate samples. The committed effective dose equivalent (CEDE) will be calculated based on representative concentrations of particulate radionuclides in air, time-weighted estimates of annual inhalation intakes (based on a reference man breathing rate and average worker exposure times in each area of the facility), and calculated Allowable Limits on Intake (ALI) or Derived Air Concentrations (DACs) based on dose conversion factors provided in International Commission on Radiological Protection (ICRP) Publication 68 (RER requests the use of the dose conversion factors in ICRP 68 “*Dose Coefficients for Intakes of Radionuclides by Workers”* (ICRP, 1994) and ICRP 72 “*Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 5, Compilation of Ingestion and Inhalation Coefficients”* (ICRP, 1995) to demonstrate compliance with occupational and public dose limits, as applicable).

10.8.2.1 Inhalation Doses from Air Particulates

Routine air monitoring will be conducted at a minimum in facilities/areas with the greatest potential to exceed 10 percent of the DAC for natural thorium, natural uranium, and long-lived decay products of each as appropriate. The RSO will first determine conservative locations for and frequency of air monitoring early in the lifecycle of operations and will adjust them as appropriate depending on the typical magnitudes and observed variation in the levels measured for various facility processes areas. An RWP, requiring non-routine air monitoring, will be issued for and cover work involving changes in routine process conditions or activities, or non-routine equipment maintenance or other special projects having the potential to exceed 10 percent of the DAC.

10.8.2.2 Inhalation Doses from Radon and Thoron

Radon and thoron concentrations in air will be monitored in real time with an instrument such as a Durridge Rad 7 electrostatic collection/alpha spectrometer (or functionally similar instrument). Occupational doses for radon can be estimated based on these measurements using currently accepted general estimates of average equilibrium fractions (e.g., 0.4 for indoor radon as adopted by ICRP, the United Nations Scientific Committee on the Effects of Atomic Radiation - UNSCEAR), and respective calculations of radon decay product concentrations (expressed in working levels - WL) along with time-weighted worker exposures expressed in working level months (WLM). The CEDE due to radon will be calculated using a dose conversion factor of 500 mrem/WLM (this is consistent with the ICRP 60 average annual limit of 2000 mrem/year), in accordance with ICRP 65 *Protection Against Radon-222 at Home and at Work* (ICRP, 1993) and UNSCEAR (2006).

Assumptions about the decay product equilibrium for thoron cannot be used to calculate dose due to its short half-life and highly variable decay product concentrations with distance from a given source. To obtain direct measures of WL concentrations for both radon and thoron, air samples will be collected on filters in conjunction with gross alpha counting at two specified times after collection in accordance with a simple, accurate method (Kann and Philips, 1986). This method, based on optimization of principles employed by the modified Kusnetz Method and similar methods (Rock, 1975; Rolle, 1972), minimizes the time to make the measurement and the complexity of the calculation. It has been shown to reduce measurement uncertainty versus earlier methods. Time-weighted worker exposures to estimate WLs will be calculated for each worker in terms of WLM. These values will be used to calculate the CEDE using a dose conversion factor of 500 mrem/WLM for radon. A dose conversion factor equivalent to one-third of this value (167 mrem/WLM) will be used for thoron, in accordance with and per NRC and ICRP conventions.

10.8.2.3 Bioassay

The calculated ALIs [1] for occupational radiation protection are $2x10^{-2}$ µCi (class M) and $5x10^{-2}$ µCi (class S), based on ICRP 68 dose conversion factors and ICRP 60 criteria for the inhalation of Th-232. The amount of a thorium inhalation intake excreted through the gastrointestinal tract will greatly exceed excretion through the urinary tract. Thus, analysis of urine samples is not expected to be an effective bioassay method for Th-232, but analysis of fecal samples is warranted. Bioassay approaches will include one or more of the following methods, to cover all potential worker radionuclide intake scenarios (for both U-nat and Th-232) at the PUG and Hydromet plants: 1) whole-body counting, 2) urinalysis, and 3) fecal analysis as appropriate for the process and potential radionuclide intake circumstances specific to each facility.

10.9 PUBLIC DOSE MONITORING

Prospective public dose evaluations for the Bear Lodge Project demonstrate that public doses from licensed activities are not likely to exceed 100 mrem per year. Appendix D presents the public dose evaluation. Public dose evaluations will be conducted annually based on stack or ventilation system emission measurements for radionuclides in air particulates; and radon and thoron gas. These source term measurements will be used in an appropriate air dispersion modeling program; e.g., AERMOD, CALPUFF, and RESRAD-OFFSITE, to calculate public doses at facility boundaries. Confirmatory measurements at facility boundaries will not be possible because there are no measurement technologies that can distinguish airborne radionuclides (U-nat, Th-232, Rn-222, Rn-220) originating from licensed materials at the PUG or Hydromet plants from unlicensed materials associated with general mining activities at the Bull Hill Mine Site or the TSF at the Upton Plant Site. Radionuclide emissions from unlicensed materials and activities at both sites are expected to dominate the potential for radiological doses to a hypothetical member of the public at the boundaries of either site.

[1] ICRP 60 recommends an average effective dose limit of 2,000 mrem/year over any five year period, not to exceed 5,000 mrem in any given year, and employs only stochastic annual limits on intake (SALI) for radiation protection purposes.

10.10 MATERIAL RECEIPT AND ACCOUNTABILITY

The licensed radioactive material to be received at the Hydromet Plant will always be the pre-concentrate and mineral ore material from the PUG Plant. Small, sealed sources could potentially be used at the on-site analytical laboratory, along with minor amounts of radioactive chemicals for use as matrix spikes or radiotracers. These materials may qualify as exempt small quantities that do not require licensing. Nuclear density gauges containing sealed sources could also be used in process facilities as flow meters or particle size monitors. Non-exempt sealed sources or other small quantities of radioactive materials, if used at the facility for such ancillary purposes, will be obtained under separate radioactive materials license application(s) for such sources, if needed.

Physical inventories will be conducted at intervals not to exceed 6 months, to account for all radioactive source materials received and possessed under this license. RER will develop procedures for the accounting of radioactive materials prior to operation, to which workers will be trained.

10.11 TRANSPORT OF RADIOACTIVE MATERIALS

All transport of licensed radioactive materials beyond restricted areas will comply with applicable DOT and NRC transportation regulations. NRC transportation regulations (10 CFR 71) apply specifically to packaging requirements for licensed material to be transported outside of licensed facilities, while the DOT regulates such shipments while they are in transit and sets standards for labeling and smaller quantity packages. Procedures to meet these regulations and all facility NRC license requirements will include the use of NRC-approved packaging/containment for shipments, contamination surveys of packages/transport vehicles; and proper package labeling, vehicle placarding and material manifest documentation; accident/emergency response procedures for all shipments of concentrated ores from the PUG Plant to the Hydromet Plant; and shipping of thorium hydroxide waste from the Hydromet Plant to an approved offsite facility for proper disposal. Vehicles used to transport materials to or from the Hydromet Plant will not access the restricted area; therefore, no decontamination will be needed provided the applicable DOT and NRC regulations for transportation of radioactive materials are met. Thorium hydroxide waste will be properly containerized in NRC-approved packaging and surveyed prior to release for offsite shipping to a licensed facility. Specific procedures for each aspect of the transport of licensed radioactive materials will be developed to ensure compliance with all applicable regulations.

10.12 OPERATING AND EMERGENCY PROCEDURES

RER will develop and document operating and emergency procedures before the generation or receipt of licensed material. These procedures will include process control, upset conditions, loss of power, etc. RER will implement and maintain the operating and emergency procedures. They will be revised only if the changes are (1) reviewed and approved in writing by the SERP and RSO; (2) in compliance with NRC regulations and the license; (3) do not degrade the effectiveness of the program; and (4) if relevant RER personnel are provided training in the revised procedures prior to their implementation.

10.13 MAINTENANCE

The maintenance of facilities and repair of process equipment are crucial not only to commercial performance but to radiation protection and keeping doses ALARA. Maintenance itself, however, can lead to routine or non-routine exposures to sources of radioactivity. Procedures for routine maintenance activities will be covered by the RSP. Non-routine maintenance, or any maintenance activities with the potential to exceed any control limit (e.g., 10 percent of applicable occupational dose limits), will require an RSO-approved RWP, as described in Section 10.6. It is expected that the need for maintenance, or the effectiveness of maintenance performed with respect to radiation safety will be reviewed and identified during routine internal inspections and evaluations of the RSP, during annual third-party audits and NRC inspections.

10.14 RECORDKEEPING

Records will be maintained in accordance with the applicable requirements of 10 CFR 20 Subpart L, including the following:

- Current RSP and all provisions (including SOPs);
- Results of internal reviews, external audits, and inspections of the RSP, including any NRC-approved changes that may have resulted from such evaluations;
- Records of surveys, workplace/environmental monitoring and sampling, and instrument calibrations;
- Records of all surveys and monitoring, with associated calculations and modeling, used to estimate radiation doses to workers and members of the public;
- Records of all measurements, monitoring, and calculations of radiological effluent releases;
- Records of occupational doses to individual workers for the current year and cumulative dose histories including prior exposures, and any doses in excess of regulatory limits, due to planned special exposures, or as a result of responses to accidental spills or releases; and
- Records of waste disposal, including materials stored in the TSF and shipped offsite for disposal at an approved facility.

In general, most of this information will be summarized in annual reports, but raw data, field notes, modeling runs, etc. (both hard copy and electronic files) also will be retained. These records will be maintained for no less than 3 years or until license termination, as specified in 10 CFR 20 Subpart L.

10.15 REPORTING

Reporting will be performed in accordance with applicable requirements of 10 CFR 20 Subpart M, and will include the following:

- Reports to NRC of theft or loss of licensed material, or other breaches of site security;
- Notification to NRC of incidents of exposures above applicable dose limits or any releases of radioactive material with the potential to result in such exposures; and
- Copies of reports to NRC will be provided to any individual regarding exceedances of any applicable dose limits as specified above.

RER will submit annually an effluent monitoring report, similar to reports required by 10 CFR 40.65. This report will include any and effluent monitoring data, the annual ALARA audit, and public dose evaluation.

Finally, RER will provide to NRC a copy of the annual report submitted to WDEQ that includes surface water and groundwater data.

10.16 QUALITY ASSURANCE/QUALITY CONTROL

RER will establish a quality assurance program applicable to the PUG and Hydromet facilities consistent with recommendations in NRC Regulatory Guide 4.15 "*Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) -- Effluent Streams and the Environment*" (RG 4.15) prior to operations. The purpose of the program is to ensure that all radiological and non-radiological measurements that support the radiological monitoring program are reasonably valid and of a defined quality. These programs are needed to (1) identify deficiencies in the sampling and measurement processes and report them to those responsible for these operations so that licensees may take corrective action and (2) obtain some measure of confidence in the results of the monitoring programs to assure the regulatory agencies and the public that the results are valid.

The quality assurance program will contain the following elements of RG 4.15:

- Organizational structure, responsibilities, and qualifications of both the management and the operational personnel;
- Qualifications of personnel;
- SOPs used in the monitoring programs;
- Records of samples, from collection to offsite shipment for analysis;
- Records of quality control of the sample analyses, including results of quality control blanks, duplicates, and cross-checks performed by other laboratories;
- Calibration and operation of equipment used in obtaining samples, measuring radiation, etc.;
- Data verification and validation procedures; and
- Data and calculations used to determine concentrations of radioactive materials, radiation doses due to occupational exposure, etc.

Quality assurance procedures will be defined for the following:

1) External Monitoring Program
2) Airborne Radiation Monitoring Program
3) Contamination Control Program
4) Airborne Effluent Program
5) Management Control Program

In general, the quality control requirements for a specific activity will be incorporated into its respective SOP.

The elements of quality assurance /quality control regarding radioanalytical methods of Section 6 of RG 4.15 will be addressed in facility SOPs, provided the data are being used to support the programs listed above. Contract analytical laboratories will be given the requirements of RG 4.15 as part of the selection process. Selection of the contract laboratory will be based partially on its ability to develop and implement the quality assurance/quality control requirements of RG 4.15.

The quality assurance program will be audited periodically. The audits will be conducted by individuals qualified in radiochemistry and monitoring techniques. However, the auditors; e.g., a consultant, will not have direct responsibilities in the areas being audited. The results of the audits will be documented and made available to members of management; e.g., RSO, Plant Manager, with the authority to enact any changes needed.

11.0 EFFLUENT MONITORING PROGRAM

Airborne emissions are expected to be the predominant pathway for human exposure at the PUG and Hydromet plants. The airborne release of radiological effluents from these facilities (the effluent subject to this licensing) are expected to be very small compared to the radiological emissions from the larger adjacent facilities (the Bull Hill mine and the TSF) that are not subject to this licensing, as demonstrated in Appendix D. Therefore, a traditional environmental monitoring program, with measurement locations sited at or near upwind and downwind boundaries of the sites and nearest human receptors will not differentiate results from licensed versus un-licensed emissions. RER will, therefore, monitor airborne radionuclide emissions from the PUG and Hydromet plants at or near release points (stacks and cooling tower) using continuous and/or grab sampling techniques to estimate license-related releases. RER will determine the airborne concentrations of radon -222, radon-220 and radioparticulates, including natural uranium and thorium, radium-226 and radium-228, and lead-210. However, given the presence of engineering controls; e.g., scrubbers and baghouses, radon-222 and radon-220 are likely the only radionuclides to be emitted in significant quantities. Impacts from these airborne releases to the nearest receptor and member of the public will be evaluated using an air dispersion computer code acceptable to the NRC. RER will develop implementing SOPs describing the locations, instruments and equipment, and methods for evaluating emissions and public dose prior to operations.

Routine liquid effluents will not occur due to the engineering controls in the PUG and Hydromet plants described in Section 9.0. Non-routine effluents will be evaluated using the SOPs described in Section 10.12. RER will neither construct or use evaporation ponds to store and treat licensed materials.

WYDEQ will require an environmental monitoring program for both the Bull Hill Mine Site and Upton Plant Site. This program will be described in the mining permit for both facilities and will include requirements for air, surface water, groundwater, soil and sediment monitoring. The data from these monitoring programs will be provided to the NRC, as described in Section 10.14.

12.0 WASTE MANAGEMENT

No licensed waste from the PUG Plant will be generated. However, the Hydromet Plant will produce two predominant waste streams: (1) the tailings to be stored in the TSF and (2) thorium hydroxide to be disposed of as low-level waste via transfer to a licensed disposal facility.

RER is applying for an exemption of the tailings material from licensing because it qualifies as an unimportant quantity of source material as defined in 10 CFR 40.13(a). Information supporting this request is presented as Appendix E to this application. The thorium hydroxide will be stored in a separate area within the Hydromet building, away from occupied structures to comply with ALARA principles, until transported to the off-site disposal facility. Equipment will be used to continuously monitor the dose rate inside the thorium hydroxide storage building. The display of the dose rate equipment will be outside the building, so any entrant can read the dose rate inside, prior to entry. The thorium hydroxide will be shipped monthly to reduce exposure rates from the ingrowth of Th-232 decay progeny.

A small amount of dry radioactive waste; e.g., spent bag house filters, contaminated PPE and other contaminated expendable items, will be generated at the Hydromet Plant during routine operations. This waste will be stored temporarily on-site in clearly marked containers, segregated from non-radioactive waste, prior to shipment to an off-site licensed disposal facility.

RER will develop detailed operating procedures regarding waste management at the Hydromet Plant, prior to the receipt of licensed material.

13.0 FEES

This information is information is provided on NRC form 313 contained in Appendix A.

14.0 CERTIFICATION

This information is information is provided on NRC form 313 in Appendix A.

15.0 REFERENCES

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