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Eagle Mesa Mine
2020 Mining and Reclamation Plan

Prepared for:

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Abbreviations and Acronyms

BLM	Bureau of Land Management
BMP	best management practice
1997 EA Analysis Area	Eagle Mesa Mine 1997 EA Analysis Area
Contract Area	Eagle Mesa Mine Contract Area
dBA	hourly A-weighted sound level in decibels
DOT	Department of Transportation
Ecosphere	Ecosphere Environmental Services
EMNRD	Energy, Minerals, and Natural Resources Department
°F	degrees Fahrenheit
FFO	Farmington Field Office
FA	financial assurance
MBTA	Migratory Bird Treaty Act
Mine	Eagle Mesa Mine
Mining Permit	Minimal Impact Mining Operation Permit
MMD	Mining and Minerals Division
MMSC	Mineral Materials Sales Contract
NAAQS	National Ambient Air Quality Standard
NM	New Mexico
NMCRIS	New Mexico Cultural Resource Information System
NMPM	New Mexico Principal Meridian
NMOSE	New Mexico Office of the State Engineer
NRHP	National Register of Historic Places
Plan	Mining and Reclamation Plan
PM	Particulate Matter
RMP	Resource Management Plan
Rammsco	Rammsco Operations, Inc.
ROW	right-of-way
RPFO	Rio Puerco Field Office
Staging area	Staging/Loading area
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Property
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
WATERS	Water Administration and Technical Engineering Resource System
Woods Canyon	Woods Canyon Archaeological Consultants

1. MINING PLAN

1.1 General Information

1.1.1 Project

This mining and reclamation plan (MRP) has been prepared for Eagle Mesa Mine (Mine), a minimal impact surface mine operated by Rammsco Operations, Inc. (Rammsco). In accordance with the 43 CFR 3600 regulations, this Plan was prepared to evaluate the current state of reclamation at the Mine and to provide an ongoing plan for mining and reclamation.

Rammsco mines two materials at the Mine—humate and "organic clay." Humate is an organic material rich with humic acids, occurring as a deposit within carbonaceous shale or claystone. It is used for various purposes, most notably as a soil amendment and livestock feed supplement. A brown, "organic clay" soil layer associated with the humate deposit in this formation is also being mined as part of mining operations. The "organic clay" contains fulvic acids and is also used as a soil amendment and livestock feed supplement. The existing Mine has been in operation since 1997.

1.1.2 Permittee

Official correspondence will also be sent to:

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1.1.3 Legal Description

The Mine is located approximately 5.5 miles west of Johnson Trading Post, 7.5 miles north of Torreon, 6 miles southeast of Ojo Encino, and 19 miles west-southwest of Cuba, New Mexico (Map A-1, Appendix A).

1.1.3.1 1997 EA Analysis Area

As shown on Map A-1 in Appendix A, the Eagle Mesa Mine is location on a 535-acre area that was analyzed in a 1997 Environmental Assessment (EA). This document summarized the existing environment, including regional and local topography, climate, rights-of-way, surface and groundwater resources, vegetation and wildlife, cultural resources, noise, air quality, demographics, and the visual setting. The EA and associated Finding of No Significant Impact authorized humate mining in Sections 8 and 9 of Township 19 North, Range 4 West, New Mexico Principal Meridian (NMPM) in Sandoval County, NM. The proposed 2020 Contract Area (see section 1.1.3.2) is located within the 1997 EA Analysis Area.

1.1.3.2 Contract Area

The Contract Area is defined as the mine access road, the area currently being mined, and the areas expected to be actively mined within the next 5 years. The active Mine is located within the Contract Area, which is located

within the 1997 EA Analysis Area as established under the MRP. The "minable Contract Area" henceforth will refer to the Contract Area minus the portion dedicated to the access road(s), which will not be mined.

The 2020 MRP proposes a new 25.81-acre Contract Area comprising a 2.33-acre active mining area; 6.94 acres of staging, storage, and roads; an additional 9.18 acres to be mined; and 7.36 partially-reclaimed acres (Table 1-1; Appendix A, Map A-2).

Table 1-1. 2020 Mineral Materials Sales Contract (MMSC)

Location/Details	2020 MMSC (Acres)
Active Mining Area	2.33
Existing Staging, Storage, and Roads	6.94
Proposed New Mining Units and Access Roads	9.18
Partially Completed Reclamation Areas	7.36
TOTAL	**25.81**

1.1.4 Administration, Contracts, and Permits

The entire 1997 EA Analysis Area is located on BLM lands. The BLM/RPFO administers the surface and mineral estate across the entire 1997 EA Analysis Area and Contract Area.

Rammsco's initial Mineral Materials Sales Contract (MMSC) for mining the humate and "organic clay" was registered with the BLM/Farmington Field Office (FFO) as Contract #NMNM128614. The MMSC was renewed in 2014 under the same contract number (NMNM128614, dated April 1, 2014). The new MMSC Contract Number is # _____ (to be filled in by BLM/RPFO).

Rammsco has been issued an existing Minimal Impact Mining Operation Permit (Mining Permit) from the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) Mining and Minerals Division (MMD), Permit Number SA009MN Eagle Mesa Mine – Minimal Impact New Mine - Modification 16-1.

Rammsco has been issued coverage under the Environmental Protection Agency's (EPA's) 2015 Multi-Sector General Permit (MSGP) for stormwater discharges related to its industrial activities under Sector J2 – Mineral Mining and Dressing, Subsector – Nonmetallic Minerals Services; Eagle Mesa Mine's EPA tracking ID is NMR053211. As part of its coverage under the 2015 MSGP, Rammsco has prepared a Stormwater Pollution Prevention Plan (SWPPP, Rammsco 2015) to document the selection, design, and installation of control measures to meet the permit's effluent limits for this sector.

1.1.5 Plan Updates

The BLM/RPFO requires this Plan to be updated or amended if Rammsco desires to make any changes to the Plan, and/or when Rammsco is prepared to begin explorations in other portions of the 1997 EA Analysis Area outside of the Contract Area. The 2020 MRP reflects mining and reclamation activities performed to date and proposes new areas of mining, road construction, and reclamation.

1.2 Existing Environment

The elevation throughout the 1997 EA Analysis Area ranges between 6,600 and 6,820 feet, and the Contract Area lies at approximately 6,660 feet. The natural topography within the mining areas consists of gently rolling hills sloping generally to the east-southeast. Slopes within the Contract Area are gentle, ranging between 0 and 5 percent. The climate within the general 1997 EA Analysis Area averages maximum year-round temperatures between 40- and 85-degrees Fahrenheit (°F) and minimum temperatures between 9.1°F and 50.2°F. Average annual rainfall in the general vicinity is 12.8 inches per year, with the highest percentage in July and August (2.1 to 2.5 inches).

The current land uses within the 1997 EA Analysis Area are livestock grazing, wildlife use, utility corridors, and mineral materials mining. The Contract Area is located within the Star Lake Community grazing allotment. The project area has been previously disturbed by past mining, grazing, and vehicle access. Existing un-improved two-track roads provide access into the Contract Area.

The Contract Area is located in the Middle Rio Grande Hydrologic Region on the east side of the Continental Divide, within the Arroyo Chico watershed. The Contract Area lies approximately 5.1 miles due north of the confluence of the San Isidro Wash and Torreon Wash—both ephemeral drainages. There are no perennial surface water resources in the form of rivers, lakes, ponds, or streams, nor any wetlands, springs, or riparian habitats within the Contract Area. The primary aquifers in the area are the sandstone-based Uinta-Animas and the Mesaverde (USGS 1995). Groundwater is readily available in most of the area and is of fair to poor quality. The minimum depth to water near the mine is 95 feet (NMOSE 2012).

The vegetation in the vicinity of the mine is characteristic of the Great Basin Desert Scrub vegetation community (Dick-Peddie 1993) and supports a variety of wildlife, including mammals, birds, and reptiles.

A 100 percent Class III pedestrian survey of the 1997 EA Analysis Area on BLM lands was conducted in 2012. The results of the literature search found that 13 previous archeological surveys had been conducted and 12 previously recorded sites had been documented within 0.5 mile of the 1997 EA Analysis Area. Four sites were located in proximity to the mineable Contract Area. All four sites will be protected and avoided through installation of high-visibility fencing using T-posts and orange plastic safety fencing around a 10-meter buffer of each site.

1.2.1 Deposit Geology

The desired geological formation containing the humate and “organic clay” material is derived from the Fruitland Formation of the Upper Cretaceous period (Beaumont 1998). There are no known potentially hazardous materials that could be exposed during the extraction of the humate material.

The humate and “organic clay” deposits in the minable Contract Area are highly variable in sequence, thickness, and extent due to previous mining, erosion, uplifts, and faulting (Figure 1-1). No natural outcroppings occur within the Contract Area. Within the minable Contract Area, site conditions are expected to include (from the surface down):

- A thin layer of topsoil (generally < 1 foot thick)
- A 4- to 6-foot layer of sand and soil overburden

- A 2- to 3-foot layer of "organic clay" (brown clay)
- A 3- to 5-foot layer of unusable (gray) clay
- A 1-foot layer of "organic clay" (brown clay)
- A 1- to 5-foot layer of humate
- Low-grade coal and unusable clay

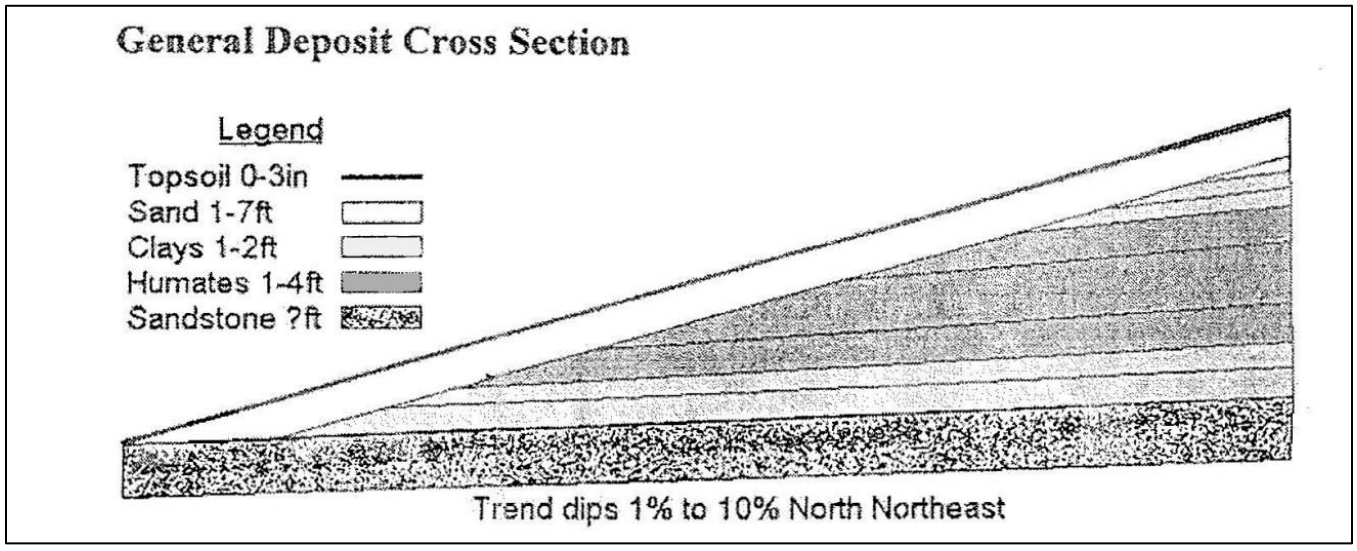

Figure 1. Generalized illustration of the distribution of humates and clays in the minable Contract Area

1.3 Proposed Operations

1.3.1 Mining Methods and Procedures

The thickness of the humate and "organic clay" layers throughout the minable Contract Area vary greatly. Rammsco has documented the humate seam on site as up to 5 feet thick and as thin as 1 foot. Remaining humate reserves in the minable Contract Area are conservatively estimated based on the assumptions of a 4-foot thick continuous humate seam across the area and a density of 1,850 pounds of humate per cubic yard (D. Williams, pers. communication, November 16, 2012). The "organic clay" layer also varies between 2 and 3 feet thick across the minable Contract Area. "Organic clay" reserves in the minable Contract Area are conservatively estimated based on the assumptions of a 3-foot thick continuous "organic clay" seam across the area and a density of 2,300 pounds of "organic clay" per cubic yard. The estimated amount of humate and "organic clay" in reserve within the 2019 Active and Additional Mining areas is estimated at approximately 40,000 tons.

Total annual humate extraction is estimated to be 3,830 tons (4,140 bank cubic yards) per year, based on an average of 15, 23-cubic yard truckloads of humate extracted per month. Total annual "organic clay" extraction is estimated to be 4,140 tons (3,600 bank cubic yards) per year, based on an average of 15, 20-cubic yard truckloads of "organic clay" extracted per month.

At an extraction rate of approximately 4,140 bank cubic yards of humate per year and approximately 3,600 bank cubic yards of "organic clay" per year, the remaining 11.95 acres of active and proposed mining areas of the minable Contract Area (Table 1-1) will take approximately 10 to 15 years to mine.

Rammsco proposes to operate the Mine periodically, and only during daylight hours on weekdays (Monday through Friday) between 8:00 am to 4:00 pm, except for holidays. Orders for humate and "organic clay" product are bunched for pickup into groups of 5 to 10 truckloads at a time, at 23 cubic yards per truckload for humate and 20 cubic yards per truckload for "organic clay." After a group of pickups is completed, mining operations are put on hold until new orders are received. On average, 13 to 15 truckloads each of humate and "organic clay" are removed from the Mine per month.

Mining operations will generally move forward in phases. Each phase will include the following steps:

Removal of Topsoil and Overburden - Topsoil will be removed using a front-end loader and stockpiled within the mining areas separate from any remaining overburden. Overburden ranges from 5 to 15 feet thick across the area and will be removed using a front-end loader and stockpiled within the mining areas for reuse during reclamation. If previously undocumented archeological, cultural, or paleontological resources are encountered during mining operations, all activities will stop in the vicinity of the discovery and the BLM Discovery Stipulation will be followed. No greater than 2 to 4 acres of excavated overburden will be stockpiled at any given time.

Stockpiles will be located and protected so that wind and water erosion are minimized, and reclamation potential is maximized. Erosion control and slope stabilization measures for the stockpiles will be implemented according to the SWPPP prepared for the Mine.

Removal of the "Organic Clay" - Using a front-end loader, the "organic clay" will be removed and placed in a collection pile. When material orders are ready for pickup, the operator will use a front-end loader to collect and load the material into haul trucks with 36-foot end-dump trailers for transport to the Certified Automated Truck Scale Company (CAT) truck scales in the Albuquerque area. Trucks are weighed, net weight of the material in the truck is calculated (i.e. gross weight is subtracted from truck weight), and a Certificate of Weight & Measure is issued to the truck driver and Rammsco.

Removal of the Humate - Any overburden occurring between the "organic clay" layer and the humate layer will be removed and stockpiled as described above. Once the humate is ready for extraction, it is removed and placed in a collection pile using a front-end loader. When material orders are ready for pickup, the front-end loader will collect and load the material into haul trucks with 36-foot end-dump trailers for transport to Certified Automated Truck Scale Company (CAT) truck scales in the Albuquerque area. Trucks are weighed, net weight of the material in the truck is calculated, and a Certificate of Weight & Measure is issued to the truck driver and Rammsco.

Product Verification and Delivery of the Humate and "organic clay" - Production rates are determined based on weight logs certified by the CAT scale public weighmaster for each load upon arrival at the truck scales. Daily and monthly logs for the humate and the "organic clay" will be presented as verification to the BLM. Copies of all records are kept at the Rammsco office in Katy, Texas.

Reclamation - Once the maximum amount of humate and "organic clay" has been extracted, reclamation will be initiated as follows (see Section 2, Reclamation Plan, for details):

- Re-placement of stockpiled overburden and topsoil over mined phase.
- Surface re-contouring of mined phase.

- Seeding and mulching of mined phase.

1.3.1.1 Equipment and Personnel Information

Rammsco proposes to operate the Mine periodically, and only during daylight hours on weekdays (Monday through Friday) between 8:00 a.m. and 4:00 p.m., except for holidays. The proposed Mine would employ one full-time employee working a maximum 8-hour shift, no more than 5 days a week.

All vehicles will be restricted to haul roads and active mine operations (Table 1-2). Once areas are reclaimed, no vehicles will be operated within the reclaimed areas except for the on-site haul road and for restoration maintenance or rehabilitation activities. The following equipment for each phase of the project would be operated by the employee.

Table 1-2. Equipment Required for Mining Plan

Equipment	Staging & Stockpiling	Mine Operation
Front-End Loader	X	X
Haul Truck & End Dump Trailer		X

1.3.2 Procedures to Prevent Damage, Degradation, Destruction

The following procedures will be followed to prevent degradation or destruction to the listed items.

1.3.2.1 Travel/Transport (Roads, Residences, Bridges, Etc.)

The travel route between the Mine site and the scales located at 301 Murray Road SE, Albuquerque, NM is expected to follow Tinian Road north of the Contract Area northeast to Indian Service Route 474, then east to State Highway 197 northeast to US Highway 550, then south to Bernalillo, and south on I-25 to Albuquerque.

All Mine-related vehicles will be required to follow posted speed limits, and all vehicles including haul trucks and personal vehicles, will adhere to load limits outlined by the New Mexico DOT and Navajo DOT. Use will be limited to only necessary travel (e.g., partial loads will not be transported). The maximum weight on bridges will not be exceeded. All loads departing the Mine will be covered for the duration of transport, according to New Mexico DOT standards, to avoid damage to windshields, etc. When encountered, right-of-way will be given to the nearby residents and school busses.

1.3.2.2 Post Mining Land Use

All Mine-related disturbance within the entire 25.81-acre Contract Area will be properly reclaimed and returned to grazing use for livestock and wildlife after mining operations have ceased. Reclamation procedures are outlined in Section 2, Reclamation Plan.

1.3.2.3 Surface and Ground Waters

Discharge of stormwater from disturbed areas to any watercourse may be a violation of the Clean Water Act. At the Mine, stormwater generated from the mining area during precipitation events collects within the closed basin created by the mining pit. Stormwater that collects within the pit is pumped into a constructed sediment basin

within the pit to infiltrate slowly back into the subsurface soils. Stormwater is therefore not discharging into any perennial or ephemeral watercourse. The mine operator and a representative from the MMD observed during a May 2013 site visit that there were no apparent outfalls from the minable Contract Area that would discharge stormwater collected during a 100-year precipitation event into any watercourse.

To prevent any potential, direct impacts to surface water and ephemeral watercourses, a variety of structural and non-structural BMPs will be used at the Mine to manage stormwater. These BMPs are described in Table 1-3 below and will comply with BLM Gold Book standards (USDI/USDA 2007). BMPs will be applied to locations described below and will remain in proper functioning condition until final stabilization is reached. BMPs will be maintained or amended by the mine operator as site conditions change throughout the mining and reclamation process.

Table 1-3. Erosion Control BMPs

BMP	How It Works	Location at Eagle Mesa Mine
Setbacks	Setting back ground-disturbing activities from perennial or ephemeral watercourses provides a buffer between potential sediment sources and the watercourse. All mining activities and associated disturbance will be set back a minimum of 100 feet from any perennial or ephemeral watercourses.	Ephemeral drainage southwest of the minable Contract Area.
Berms	Soil berms built on the downhill side of a disturbed area (either in the active mining area or the reclaimed area) trap stormwater. Berms will be 3 feet high and compacted to be effective.	Topsoil and overburden stockpiles, and at the base of any sloped, disturbed areas that drain outside of the Contract Area.
Mining Pit	In the open pit area, all stormwater is contained in the pit.	Active mining area.
Rapid Reclamation	Rapid reclamation (surface contouring, surface roughening, and seeding) help to stabilize soil with vegetation.	Topsoil and overburden stockpiles, reclaimed areas.
Sediment Basin	There is one sediment basin within the Mine, which collects stormwater from the eastern half of the Mine. It is a closed basin (no outlet). Southwest of the minable Contract Area are two sediment basins (or stock ponds), which collect and hold for infiltration some surface runoff from the extreme southwest portion of the active mining area. All three impoundments allow the sediment to settle out of the water, and the water to infiltrate back into the subsurface soils.	Centrally-located among Phase II Mining areas.
Surface Contouring	Surface contouring (grading) creates low spots where water collects or directs stormwater into a sediment pond.	Reclaimed areas.
Stockpile Location Planning	All stockpiles will be located on flat ground, away from drainage areas. This reduces the chance of materials slumping downhill or being carried away by surface water flows.	Active mining and storage areas.
Stockpile Stabilization	Topsoil and overburden soils to remain stockpiled greater than 6 months (180 days) will be seeded with the	Topsoil and overburden stockpiles.

BMP	How It Works	Location at Eagle Mesa Mine
	herbaceous components of the reclamation seed mix provided in Section 2.5.3–Seeding to provide erosion control. This will protect the soil from eroding or mobilizing and will maintain the existing microorganisms and other soil constituents through natural nutrient cycling. Shrub seed is not required for stockpile stabilization. Soil berms will be constructed around the base of the stockpiles to 3 feet high and compacted.	
Surface Roughening	Surface roughening creates small ridges and gullies with the teeth of the bucket of the front-end loader or with the grooves of tracked equipment. These ridges and gullies go across the slope (that is, along the contour of the slope), trapping stormwater and helping with revegetation. To create these ridges/gullies with tracked equipment, the equipment will be run up/down the slope (that is, perpendicular to the contour of the slope).	Reclaimed areas.

Additional erosion control and stormwater monitoring procedures are outlined in the *Stormwater Pollution Prevention Plan for Eagle Mesa Mine*.

1.3.2.4 Vegetation and Wildlife

All activities during all phases of mining operations will be restricted to the boundaries of the Contract Area (see Map A-2 of Appendix A). Extreme care will be taken to avoid all wildlife or livestock within the roads and surrounding area.

In accordance with the Migratory Bird Treaty Act (MBTA), any vegetation clearing required to prepare undisturbed areas of the Contract Area to be mined will be cleared between October 1 and March 31 to avoid damaging or destroying any migratory bird nests, which is considered a violation of the MBTA.

1.3.2.5 Invasive Species/Noxious Weeds

In accordance with the standard operating procedures found in BLM/RPFO Instruction Memorandum NM-010-99-01 (USDI/BLM 1999), an approach for weed prevention and treatment is included in this Plan. The mine operator will manage and control noxious weeds throughout the life of the mining operation until final reclamation has been achieved. A list of noxious weeds identified as occurring on BLM/RPFO lands is provided in Section 2.7, Invasive/Noxious Species Control, and a list of weeds identified for control by the State of New Mexico is provided in Appendix C: Noxious Weed Information. Control of noxious species is discussed further under Section 2.7, Invasive/Noxious Species Control.

Saltlover *(Halogeton glomeratus)*, a state Class B noxious weed species, is scattered across the Contract Area. No other invasive, non-native species listed by the State of New Mexico were identified in the Contract Area during field surveys. Discussion of control and treatment of existing *Halogeton* is included in Section 2.4.1, Initial Reclamation.

1.3.2.6 Air Quality, Noise, Light, and Vibration

Operations will occur only during daylight hours. Minimal amounts of equipment will be used to accomplish the mining operations.

1.3.2.7 Visual Resources

Impacts to visual resources are related to land disturbance, amount and types of equipment, machinery, and vehicles, infrastructure, and project emissions. Siting and design considerations to reduce, avoid, or mitigate visual impacts at the mining site will include:

- Minimization of all surface (ground) disturbances for all road or facilities infrastructure.
- To the extent practicable, location of facility infrastructure or equipment storage will not be on high land features and along "skylines" that are readily visible from nearby sensitive viewpoints.
- Storage of equipment and vehicles will be kept within the limits of the initially disturbed areas.
- Avoiding impacts to public road ROWs. Existing vegetation and topography within the ROWs will be left undisturbed.
- Minimization of vehicular and human activities as practicable during mining operations. Neither vehicular nor human activities will occur outside of daylight hours to minimize disturbance to neighboring landowners.

1.3.2.8 Site Housekeeping

The Contract Area will be regularly maintained to keep a tidy site. Equipment kept on site will be stored neatly in the staging areas when not in use, including heavy equipment, vehicles, hoses, pumps, trash bins, etc. Equipment that is inoperable will be removed from the site and not stored at the site. In general, inoperative equipment and poor housekeeping creates a poor image of the activity in the eyes of the public.

Since Rammsco operates on an on-demand basis for the materials being extracted, the Mine is not active every day. All heavy equipment used in the project area will be inspected for leaks on each day that the mine operator is on site and the Mine is active/in operation, and a written log of inspections and maintenance will be completed each day that the Mine is active/in operation. The inspection and maintenance logs will be kept on site or in the mine operator’s possession whenever the operator is on site.

1.3.2.9 Secondary Containment

Within the Staging Area, a secondary containment area will be constructed by laying an impervious liner on stable, level ground to prevent infiltration to groundwater, and constructing a compacted soil berm to prevent runoff from contaminating other soil or surface water. All surfaces within the secondary containment area including the containment berms will be sufficiently impervious to contain any spilled or released material. Containment berms are not to be constructed with topsoil or coarse, insufficiently impervious overburden material.

Secondary containment areas will be constructed to fully accommodate any fuel, lubricant, or other petroleum hydrocarbon material storage as well as any fuel supply vehicles and will enclose an area sufficient to contain 150 percent of the largest single fuel/lubricant tank. The secondary containment area will be inspected at regular

intervals and maintained in good condition. No potential ignition sources will be placed or stored inside the secondary containment area. “No Smoking” signs will be placed prominently around the secondary containment area so as to be visible from all directions.

1.3.2.10 Waste Disposal

General domestic solid wastes (garbage) are considered non-hazardous materials, and include food wastes, non-hazardous packaging wastes, non-petroleum oils and greases, and other non-hazardous solid materials considered inert.

Due to possibility of theft and vandalism at the mining site, no waste container will be located on-site. All domestic solid wastes will be collected daily by the mine operator, removed from the site, and disposed of legally and properly at an appropriate off-site waste disposal facility. No illegal dumping or littering will occur.

The following materials are considered potentially hazardous materials and will be disposed of at a legal, appropriate, off-site, permitted hazardous waste disposal facility:

- Spent oil filters and petroleum containers
- Used car/truck/equipment batteries
- Pressurized or empty aerosol cans
- Empty reagent containers or drums
- Other containers holding resins, solvents, glues/cements, cleaners, or paint
- Used petroleum products
- Absorbent materials used in any spill cleanup

Potentially hazardous wastes will be containerized, and these wastes and empty hazardous materials containers will be periodically removed for disposal in conformance with all applicable federal and state requirements. At the completion of all mining and reclamation activities, all hazardous materials and hazardous wastes will be removed from the site and disposed of properly.

1.3.2.11 Spill Prevention and Response Plan

All spills will immediately be reported to the BLM/RPFO and to the NMED as required by the New Mexico Water Quality Control Commission Regulations (20.6.2.1203 NMAC). For non-emergencies during normal business hours, call the NMED at (505) 476-6000. For non-emergencies during normal business hours, call the BLM at (505) 761-8700. For non-emergencies after hours, call (866) 428-6535 or (505) 428-6535 (voice mail, 24 hours a day). For emergencies only, call (505) 827-9329 24 hours a day (NM Department of Public Safety).

A spill cleanup kit will be maintained at the Mine site at all times or within the mine operator’s work vehicle at the Mine site during all hours of operation. Typically, a spill cleanup kit is capable of cleaning up to a 25-gallon spill. The contents of the spill cleanup kit include absorbent materials, disposable waste bags, and personal protective equipment.

Spills will be controlled using absorbents. Once the spill source is stopped and the spill is retained, the absorbents will be removed and placed in the disposable waste bags and stored in a well-ventilated location until they can be

disposed of properly off-site. Petroleum hydrocarbon contaminated soils will be removed completely and placed in the secondary containment area.

Soils contaminated with petroleum hydrocarbons will be remediated in accordance with the following procedures:

- Excavate and collect all traces of contaminated soil from the spill site immediately after spill or leakage is discovered.
- Contaminated soils will be collected in clean, covered 50-gallon containers, clearly labeled "Contaminated Soils" and stored within the secondary containment area pending disposal.
- Contaminated soil will be taken to an off-site solid waste facility permitted to accept petroleum hydrocarbon contaminated soils for disposal in accordance with all applicable federal and state requirements.

A record will be maintained for all spills and will contain the following information:

- Date and time of the event
- Name of spill reporter
- Location of the spill
- Spill cause
- Type of contaminant
- Spill volume
- Determination of the affected areas
- Any affected communities
- Corrective actions taken

Where required, a report will be submitted to the pertinent federal or state authorities. A sample spill report is included in the BLM's Gold Book and can be downloaded online (USDI/USDA 2007). Incident documentation will be kept on file with Rammsco, Inc. for a minimum of 5 years.

1.3.2.12 Mine Safety

Mining and reclamation operations will be designed and operated to safeguard the general public. *Caution* signs and *Unauthorized Personnel—Keep Out* signs will be posted at the Mine. During mining operations, pit/quarry side slopes will be regularly graded to angle of repose or less to prevent slope collapse or trench stabilizers will be used. Final slopes of all reclaimed areas will not exceed the ratio of 3-foot height to 1-foot vertical (3H:1V). Shafts, adits, highwalls, and tunnels are not present or part of the humate mining process; therefore, these do not pose a hazard to Mine personnel or the public.

1.3.2.13 Archeological, Paleontological, Historical, and Cultural Sites

If previously undocumented cultural sites are encountered during construction, all activities will stop in the vicinity of the discovery and the BLM/RPFO will be immediately notified. The site would then be evaluated. Mitigation measures such as data recovery may be required by the BLM/RPFO to prevent impacts to newly identified cultural resources.

If previously undocumented paleontological resources or artifacts are discovered or encountered during any Mine operations, all activities will immediately stop near the discovery and the BLM Discovery Stipulation will be followed:

> ***BLM Discovery Stipulation***
> *The permittee will immediately notify the BLM Authorized Officer of any paleontological resources discovered as a result of operations under this authorization. The permittee will suspend all activities in the vicinity of such discovery until notified to proceed by the Authorized Officer and will protect the discovery from damage or looting. The permittee may not be required to suspend all operations if activities can be adjusted to avoid further impacts to a discovered locality or be continued elsewhere. The Authorized Officer will evaluate, or will have evaluated, such discoveries as soon as possible, but not later than 10 working days after being notified. Appropriate measures to mitigate adverse effects to significant paleontological resources will be determined by the Authorized Officer after consulting with the operator. Within 10 days, the operator will be allowed to continue construction through the site, or will be given the choice of either (1) following the Authorized Officer's instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or (2) following the Authorized Officer's instructions for mitigating impacts to the fossil resource prior to continuing construction through the project area.*

2. RECLAMATION PLAN

2.1 Objectives

The objective of the Rammsco Eagle Mesa Mine humate mining operation is to extract the permitted mineral resource and reclaim all disturbed areas of the mining operation to a condition as good as or better than the pre-mining surface. The reclaimed areas will be a self-sustaining ecosystem blending with the undisturbed ecosystem surrounding the operation over time.

Pre-mining land use is livestock grazing and wildlife habitat. Post-mining land use is expected to be the same or similar. The location of the mining operation is within the current Star Lake Community grazing allotment, which receives moderate to heavy grazing use by cattle and horses.

All reclaimed areas will be stable and exhibit none of the following characteristics:

- Large rills or gullies (greater than 3 inches wide or deep)
- Perceptible soil movement or head cutting in any drainages
- Slope instability on or adjacent to the reclaimed area

2.2 Visual Resource Standards

The reclaimed landscape will approximate the visual quality of adjacent and surrounding areas regarding surface contouring, drainage patterns, vegetation, and visual texture. All facilities and infrastructure will be removed upon completion of mining activities and disturbed surfaces, access roads, and the Mine site will be restored to as near-natural contours as feasible according to the progressive reclamation plan. All identified disturbed areas will be revegetated using plant species appropriate to the site (Table 2-1).

2.3 Reclamation Bond

As part of the MMD Mining Permit and the BLM/RPFO MMSC, an FA estimate from the mine operator is required. This estimate is based on the cost of reclaiming the site by a third party. The FA bond will be placed jointly in the name of the State of New Mexico EMNRD-MMD and the United States Department of the Interior/BLM. Applicable bonding methods include a Surety Bond, CD, or a cash account. MMD can provide further information on bonding methods if needed. MMD requires a minimum 12-year period after reclamation for withholding release of the FA for third-party re-vegetation costs. Other FA for reclamation costs such as earth moving may be released earlier pursuant to 19.10.12.1210 NMAC.

A reclamation bond estimate is provided in Appendix B. The estimate is for a reclamation area of 25.81 acres.

2.4 Reclamation Sequence

2.4.1 Initial Reclamation

Rammsco has completed earthwork and seeding for approximately 7.36 acres of previously mined areas (Map A-2, Appendix A). However, as discussed during the November 2, 2018 site visit to the Mine, saltlover (*Halogeton glomeratus*), a Class B noxious weed in the State of New Mexico, was observed growing in the portion of the

mine seeded in 2018, in the northwest section. Rammsco, in accordance with Condition 9.P of MMD Permit Modification 16-1, will continue to:

1. Train on-site personnel to recognize *Halogeton*,
2. Complete two inspections per year (in May-June and after monsoon season) of all disturbed areas,
3. Spot-treat *Halogeton* plants using an appropriate herbicide in strict accordance with the manufacturer's recommendations or remove *Halogeton* mechanically, and
4. Decontaminate new mining equipment prior to introduction into the Contract Area.

2.4.2 Ongoing Reclamation

Reclamation of the Mine site will be accomplished in concert with mining activities. As the mineral resources have been extracted and the mining operation moves into the next area, reclamation of the just-completed mined area will be initiated. This sequence will continue through all Mining phases.

Reclamation of mined areas will occur as follows:

- Surface Re-contouring and Seedbed Preparation
    - Backfill of excavated areas with stockpiled subsurface overburden materials
    - Contouring of reclaimed subsurface to 3H:1V or flatter
    - Even placement of stockpiled topsoil over area to be reclaimed
    - Harrowing of final topsoil grade for seedbed preparation
- Seeding and Mulching
    - Seed application by broadcast or drill seeding (preferred)
    - Application of mulch
    - Stabilizing mulch through punching or crimping
- Monitoring
    - Baseline plots established
    - Two randomly located transects within each reclaimed phase
- Invasive/Noxious Species Control until release of bond

Final reclamation for the Contract Area will include final grading, soil preparation, seeding, mulching, erosion control, and fencing of the all remaining disturbed (un-reclaimed) areas within the Contract Area.

The MMD requires at least 2 weeks' notice prior to the commencement of reclamation approved in this Reclamation Plan.

2.5 Reclamation Activities

2.5.1 Surface Re-contouring

Excavated areas will be backfilled with stockpiled subsurface materials only; topsoil will not be placed as backfill. Subsurface soils will then be contoured (graded) to match original slopes as closely as practicable, with no slopes exceeding 3H:1V. Stormwater runoff will be contained using the existing catch-pond in area R-1, and

additional catch-ponds or other BMPs will be designed to contain surface water runoff within the Contract Area and follow the USEPA's Stormwater discharge regulations for all remaining phases.

2.5.2 Seedbed Preparation

Areas of compacted subsoils will be ripped to a depth of 12 inches, followed by disking to a depth of 6 inches before placement of topsoil. The topsoil layer in the Mine is relatively thin and stockpiled quantities are limited; therefore, a minimum of 4 inches of stockpiled topsoil will be placed evenly over the re-graded subsurface soils. The surface will then be tine- or chain-harrowed to break up any soil clumps, smooth the surface grade, and prepare the soil for seeding.

No soil amendments or fertilizers will be applied to reclamation areas. The MMD does not support the use of chemical fertilizers in reclaimed areas, as they generally promote the growth of weedy annual species that may suppress the establishment of native perennial species.

2.5.3 Seeding

Seed will be sowed across the mine reclamation areas using broadcast or drill seeding methods. Drill seeding will be accomplished using a disk-type drill with two boxes for various seed sizes. Drill rows will be 8 to 10 inches apart, and the seed will be placed no deeper than one-half inch below the surface. After drilling, a packer or roller will be used to achieve adequate compaction and ensure uniform seed coverage. Drilling will follow the contour, and not up and down the slope. The recommended seed mix and drill seeding rate is provided in Table 2-1**.**

Where drill seeding is not practicable due to topography, the contractor will hand-broadcast seed using a "cyclone" hand seeder or similar broadcast seeder. Seed will then be raked-in so that it is planted no deeper than one-half inch below the surface. Broadcast application of seed requires a doubling of the drill seeding rate. The recommended drill seeding rate is provided in Table 2-1.

Table 2-1. Seed Mix and Recommended Drill Seeding Rate

Species	Application Rate[1] (lbs/acre)	Contribution in Seeds/sq. ft. Based on Planting Rate
Western wheatgrass (*Pascopyrum smithii*)	5.0	13
Blue grama (*Bouteloua gracilis*)	2.0	38
James' Galleta (*Pleuraphis jamesii*)	2.0	8
Indian ricegrass (*Achnatherum hymenoides*)	4.0	13
Mountain brome (*Bromus marginatus*)	4.0	6
Fourwing saltbush (*Atriplex canescens)*	3.0	4
Scarlet globemallow (*Sphaeralcea coccinea*)	0.1	2
TOTAL:	**20.1**	**84**

[1] If broadcast seeding, this rate will be doubled.

The seed mix in Table 2-1 has been recommended by the New Mexico EMNRD MMD in humate mine areas where halogeton is present. Any seed mixture used in reclamation or erosion control activities will be certified weed-free, with no primary or secondary noxious weeds in the seed mixture. Seed labels from each bag will be kept on site and made available to the BLM staff for inspection during seeding activities.

Seeding will be repeated if a satisfactory stand has not established as determined by the BLM's authorized officer following evaluation after the second growing season (USDI/BLM 2012), or as determined by the MMD representative for release of the FA bond.

2.5.4 Mulching

Straw mulch will be applied by hand broadcasting or blowing to a uniform depth of 2 to 3 inches, equivalent to a rate of about 2 tons per acre (one 74-pound bale per 800 square feet). Only certified weed-free straw will be used for mulching.

Straw mulch will then be anchored using one of the following methods:

- **Hand Punching**—A spade or shovel is used to punch straw into the slope at 12-inch intervals until all areas have straw standing perpendicularly to the slope and embedded at least 4 inches into the slope.
- **Roller Punching**—A roller equipped with straight studs not less than 6-inches long, from 4- to 6-inches wide and approximately 1-inch thick is rolled over the slope.
- **Crimper Punching**—Like roller punching, the crimper has serrated disk blades about 4-to 8-inches apart, which force straw mulch into the soil. Crimping will be done in two directions with the final pass across the slope.

2.5.5 Reclamation Protection/Fencing

During and following all mining and reclamation activities, Rammsco will monitor and protect the landscape to help ensure reclamation success to the BLM and MMD requirements. A 3-strand wire fence (top wire smooth, bottom two wires barbed) with wires at 16, 26, and 38 inches above the ground and stays approximately 15 feet apart has been installed (Map A-2, Appendix A) to protect the mine from livestock and human disturbance. This fencing conforms to New Mexico Department of Game and Fish standards for fencing in big game habitats. Fencing may be removed by the mine operator at the time the reclamation is deemed successful by the BLM/RPFO and the MMD. T-posts will be installed around all areas where earthmoving has been completed to alert the operator and protect these areas from mine operations. Fencing will also be erected around the vegetation reference area and north and east of the proposed road to prevent access to the active mine site ("New Fence", Map A-2, Appendix A)

2.6 Final Reclamation of Haul Roads

When all mining and reclamation activities have been completed within the Contract Area, all remaining haul roads will be ripped to a minimum depth of 12 inches. After ripping, water bars will be installed. The haul road alignments will then be harrowed using a tine- or chain-harrow to break up any soil clumps, smooth the surface grade, and prepare the soil for seeding. Seed and mulch will be applied as directed for Reclamation Activities (see Sections 2.5.3, Seeding and 2.5.4, Mulching).

Following seeding and mulching of the haul roads, and upon final exit of the Contract Area with all mining and reclamation equipment, an earthen barricade will be constructed just south of Tinian Road, across the entrance to the main haul road, to deter future vehicle access to the reclaimed Contract Area.

Invasive and noxious species control requirements will be applicable to reclamation of all haul roads in addition to all reclaimed mining areas.

2.7 Invasive/Noxious Species Control

Noxious weed control is a BLM-required compliance action for surface reclamation (USDI/BLM 2012). The objective of the BLM/RPFO weed management program is to detect invasive plant species populations, prevent the spread of new invasive populations, manage existing populations using the tools of integrated weed management, and eradicate invasive populations using the safest environmental methods available. Preventing the introduction of noxious weeds into an area is the most effective and economical means of weed control and management.

The BLM/RPFO list of invasive, non-native plant species of concern and the New Mexico Noxious Weed List are provided in Appendix C.

Rammsco will take all reasonable precautions to prevent the introduction, establishment, and spread of noxious weeds on lands covered by this Mine project and on adjacent lands. Noxious weed treatment and control will be done as necessary to promote revegetation with native plants and prevent the spread of noxious weeds. Prevention methods will be implemented before, during, and after all mining and reclamation activities to reduce the spread of noxious weeds or the invasion of disturbed areas by undesirable plant species. These prevention methods include:

- Removing all mud, dirt, and plant parts from all off-road equipment used at other projects before moving them into the Contract Area
- Using only defined and established travel routes to minimize soil disturbance
- Using weed-free mulch to protect establishing vegetation

The mine operator will be responsible for weed identification and control on disturbed and reclaimed areas within the limits of the Mine and associated roads. The mine operator will conduct a weed survey to identify noxious species twice every year (once early in the growing season [May] and once after the monsoon season [September]). The mine operator is responsible for consultation with the BLM and/or local authorities for acceptable weed control methods. During any Stage of mining operations, any noxious or invasive species observed within the mining area will be treated in a manner consistent with the BLM/RPFO standards.

Use of pesticides and herbicides will comply with applicable federal/state laws. Pesticides and herbicides will be used only in accordance with their registered uses and within limitations imposed by the Secretary of the Interior. Prior to the use of pesticides or herbicides, the mine operator will obtain from the BLM written approval of a plan showing the type and quantity of material to be used, pest(s) to be controlled, method of application, location of storage and disposal of containers, and any other information deemed necessary. Emergency use of pesticides or herbicides will be approved in writing by the BLM/RPFO prior to use.

2.8 Revegetation Monitoring

Revegetation monitoring will occur throughout the bonding period.

2.8.1 Vegetation Reference Area

The Vegetation Reference Area will be used as a standard of comparison for determining revegetation success for perennial vegetation cover. The Vegetation Reference Area is a 1-acre area undisturbed by mining operations, located at the southwest corner of the mine, inside the fence, and containing established native vegetation cover equivalent to the undisturbed areas of the Mine (Map A-2, Appendix A). Upon final approval of the location by the MMD, the Vegetation Reference Area will be fenced to prevent human or livestock disturbance.

2.8.2 Methodology and Success Criteria

Reclamation revegetation monitoring will incorporate two methodologies—ocular estimation for overall vegetative cover and belt transects for shrub cover. Data gathered from the Vegetation Reference Area will constitute the basis of performance standards for determining reclamation success. Revegetation monitoring locations, methods, and success criteria will be approved by the MMD prior to monitoring commencement.

2.8.2.1 Ocular Estimation (Overall Vegetation)

Vegetation cover monitoring will be conducted by ocular estimation, a vegetation monitoring technique used to determine the vegetative cover of a reclamation area compared to vegetative cover in a pre-designated reference area (the Vegetation Reference Area).

A quadrat or frame plot 20 cm x 50 cm in size will be utilized. Ten quadrats will be randomly placed in the Vegetation Reference Area and data from the quadrat plots collected. In the area of reclamation, 10 quadrats will be randomly placed for every full acre of reclamation and data from the quadrat plots collected. For reclamation acreage under one full acre, at least 10 quadrats will be randomly placed within the reclamation area. One hundred percent bare soil will not be accepted as reference data for a quadrat plot.

The percent of ground covered within the quadrat will be estimated (to the nearest percent) as a vertical projection. Ground cover will be recorded by vegetation, litter (including woody debris), rock, or bare soil. Vegetation data will be reported by individual species and by total vegetation cover. Species values can exceed 100 percent due to overlap. Total vegetation cover, when added to the vertical projection of litter, rock, or bare solid contained within the plot, will equal 100 percent.

Total vegetation cover for the Vegetation Reference Area will be determined as an average of the total vegetation cover of the 10 quadrat plots. This total vegetation cover constitutes the basis of performance standards for the reclamation areas.

Total vegetation cover for the reclamation area will be determined as an average of the total vegetation cover across all quadrat plots for the reclamation area. This total vegetation cover will be compared to the Vegetation Reference Area cover as part of determining overall reclamation success.

Sorensen's Similarity Index for vegetation cover will be provided in the final monitoring report for review by the BLM/RPFO and MMD. Sorensen's Similarity Index can be calculated as follows (Sorenson 1948):

$$SI = \frac{2C}{A + B} \times 100$$

Where: *SI* = Similarity Index;
A = Total number of species in Vegetation Reference Area;
B = Total number of species in Reclamation Area; and
C = Number of species common to both communities.

2.8.2.2 Belt Transect (Shrubs)

Revegetation monitoring of shrub cover/density per acre will be determined through belt transect methodology. A randomly-placed 50-meter straight-line transect is established within the survey area (Vegetation Reference Area or Reclamation Area) using a 50-meter tape secured at both ends. Shrubs are counted within the area extending one meter from the transect line, on one side of the tape only (the 'belt'). The number of shrubs that are rooted within the 1-meter-wide belt are counted, even if all of the shrub canopy is not within the belt. Shrubs that are not rooted within the belt are not counted. The number of shrubs per acre is obtained by multiplying the number of shrubs counted in the belt by 43,560, then dividing the product by the area of the belt, or 538.196 (50 square meters = 538.196 square feet).

Two shrub belt transects will be counted within the Vegetation Reference Area, and the number of shrubs per acre averaged between the two transects. This shrub cover/density per acre constitutes the basis of performance standards for the reclamation areas.

For the reclamation areas, two shrub belt transects for every 1 acre of reclamation will be counted. Acreages will be rounded to the nearest whole number. For example, if the reclamation area is 4.6 acres in size, the acreage would be rounded to 5, and ten randomly placed belt transects will be counted. Similarly, a 4.3-acre reclamation area would be rounded to 4 acres, and eight belt transects counted. The number of shrubs per acre within the reclamation area will be an average of all the shrubs-per-acre counts for all the belt transects in the reclamation area. This total shrub cover/density per acre will be compared to the Vegetation Reference Area cover/density as part of determining overall reclamation success.

2.8.2.3 Success Criteria

Revegetation success criteria is based on professional judgment of reasonable expectations for revegetation in the arid Great Basin Desert Scrub vegetation community over the course of a 12-year FA bonding period. Success criteria may be revised by the BLM/RPFO or the MMD based on agency-specific requirements.

Vegetation cover at the Mine will be considered successfully attained if the reclaimed area equals at least 75 percent of the vegetation cover in the Vegetation Reference Area. Species diversity using the Sorenson Similarity Index will approximate Vegetation Reference Area conditions, and invasive species percent cover does not exceed that of the Vegetation Reference Area.

Shrub cover/density per acre will be considered successfully attained if the reclaimed area shrub density per acre equals at least 35 percent of the shrub density of the Vegetation Reference Area.

2.8.3 Bond Release

Once the FA bond period is attained and the vegetative success criteria standards are met, Rammsco will prepare and submit a letter requesting the BLM and MMD release Rammsco from financial responsibility for the mining area. MMD requires a minimum 12-year period after reclamation for withholding release of FA for third-party

revegetation costs. Other FA for reclamation costs, such as earth-moving, may be released earlier pursuant to 19.10.12.1210 NMAC; however, BLM does not have the same provision.

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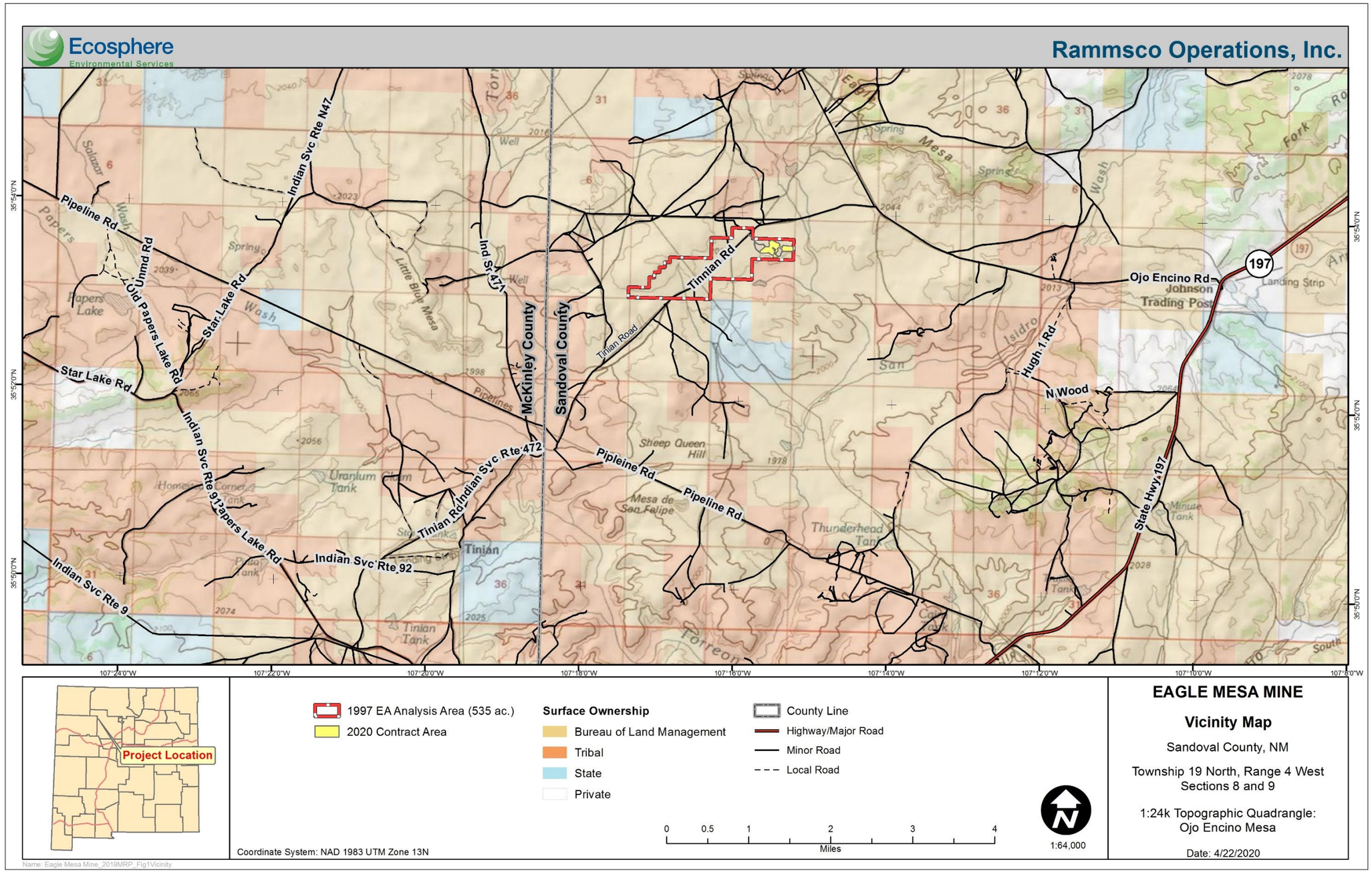
3. List of Preparers

Name	Title	Role
Jerusha Rawlings	Project Manager	▪ Project Management ▪ Technical Review ▪ GIS and Mapping
Karin Freeman	GIS	▪ Technical Review ▪ GIS Support
Cindy Lancaster	Senior Technical Editor	▪ Document Formatting ▪ Editing ▪ Quality Control

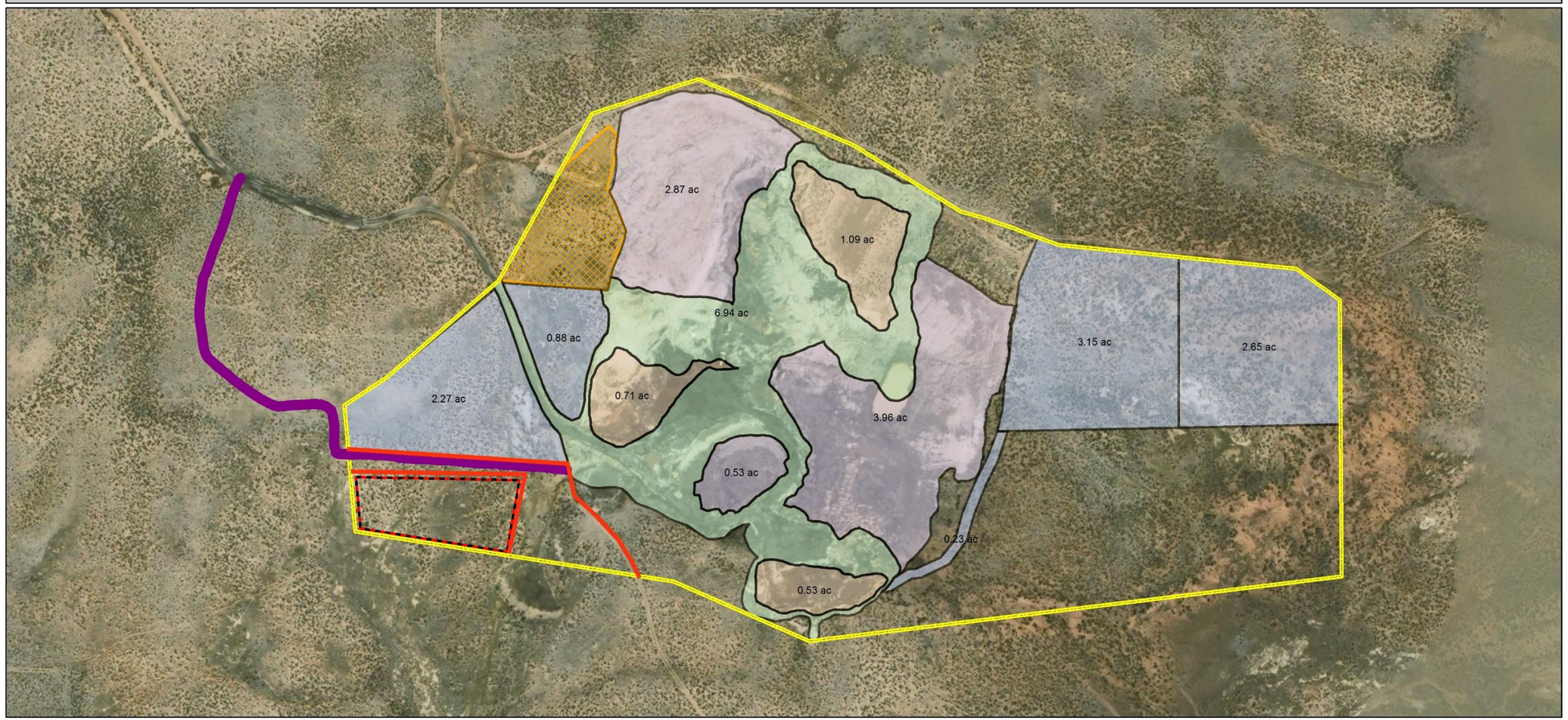
Appendix A – Maps



Map A-1. Vicinity Map

Ecosphere Environmental Services

Rammsco Operations, Inc.



Name: WorkingMap_EagleMesaMine_2019MRP_ContractArea

Map A-2. 2020 Contract Area

Appendix B – Reclamation Cost Estimate

Eagle Mesa Mine Financial Assurance Calculation

Surface Disturbance			Notes
Total Acres:	25.81		
First Acre:	$ 8,900.00		
Next 24.81 Acres:	$ 121,569.00		
Earthmoving complete credit (7.36 acres @80%)	$ (28,851.20)	*per 4/14/2020 email from C. Parson (BLM) to J. Rawlings (Ecosphere) removing 0.61676 acres of area claimed to have earthmoving completed	
Subtotal:	$ 101,617.80		
TOTAL: With five year escalation at 2.5%:	$ 114,971.21		

Boreholes

Number	Depth (Feet)	$ Per Foot	Cost
		$10.00	$ -

Revegetation Failure @ 5%/year of $1000 per acre

Acres	Years	$ Per Acre	Cost	Notes	Potential Release Date
	12	$600	$ -	Mod 18-1, release of _____ acres	2031
	12	$600	$ -		
	12	$600	$ -		
	12	$600	$ -		
0			$ -		

TOTAL FA NEEDED	$ 114,971.21			
Existing FA	$106,885.98	ILOC 0128-012715	$50,813.00	
		ILOC 0502-050115	$50,000.86	
		ILOC 0916-091517	$6,072.12	
Add'l FA required:	**$ 8,085.23**			

Appendix C – Noxious Weed Information

Invasive, Non-Native Plant Species of Concern within the BLM/RPFO[1]

Common Name	Scientific Name
Camelthorn	*Alhagi maurorum*
Tree of Heaven	*Ailanthus altissima*
Cheatgrass	*Bromus tectorum*
Hoary cress (Whitetop)	*Cardaria draba*
Musk thistle	*Carduus nutans*
Diffuse knapweed	*Centaurea diffusa*
Spotted knapweed	*Centaurea maculosa*
Russian knapweed	*Centaurea repens*
Yellow starthistle	*Centaurea solstitialis*
Canada thistle	*Cirsium arvense*
Bull thistle	*Cirsium vulgare*
Halogeton	*Halogeton glomeratus*
Tall whitetop (Perennial pepperweed)	*Lepidium latifolium*
Dalmatian toadflax	*Linaria dalmatica*
Yellow toadflax	*Linaria vulgaris*
Scotch thistle	*Onopordum acanthium*
African rue	*Peganum harmala*
Saltcedar	*Tamarix spp.*

[1]USDI/BLM 2012

New Mexico Noxious Weed List

Updated September 2016

Class A Species

Class A species are currently not present in New Mexico, or have limited distribution. Preventing new infestations of these species and eradicating existing infestations is the highest priority.

Common Name	Scientific Name
Alfombrilla	*Drymaria arenariodes*
Black henbane	*Hyoscyamus niger*
Brazillian egeria	*Egeria densa*
Camelthorn	*Alhagi psuedalhagi*
Canada thistle	*Cirsium arvense*
Dalmation toadflax	*Linaria dalmatica*
Diffuse knapweed	*Centaurea diffusa*
Dyer's woad	*Isatis tinctoria*
Giant salvinia	*Salvinia molesta*
Hoary cress	*Cardaria spp.*
Leafy spurge	*Euphorbia esula*
Oxeye daisy	*Leucanthemum vulgare*
Purple loosestrife	*Lythrum salicaria*
Purple starthistle	*Centaurea calcitrapa*
Ravenna grass	*Saccharum ravennae*
Scentless chamomile	*Matricaria perforata*
Scotch thistle	*Onopordum acanthium*
Spotted knapweed	*Centaurea biebersteinii*
Yellow starthistle	*Centaurea solstitialis*
Yellow toadflax	*Linaria vulgaris*

Class B Species

Class B Species are limited to portions of the state. In areas with severe infestations, management should be designed to contain the infestation and stop any further spread.

Common Name	Scientific Name
African rue	*Peganum harmala*
Bull thistle	*Cirsium vulgare*
Chicory	*Cichorium intybus*
Halogeton	*Halogeton glomeratus*
Malta starthistle	*Centaurea melitensis*
Perennial pepperweed	*Lepidium latifolium*
Poison hemlock	*Conium maculatum*

Quackgrass	*Elytrigia repens*
Russian knapweed	*Acroptilon repens*
Spiny cocklebur	*Xanthium spinosum*
Teasel	*Dipsacus fullonum*

Class C Species

Class C species are wide-spread in the state. Management decisions for these species should be determined at the local level, based on feasibility of control and level of infestation.

Common Name	Scientific Name
Cheatgrass	*Bromus tectorum*
Curlyleaf pondweed	*Potamogeton crispus*
Eurasian watermilfoil	*Myriophyllum spicatum*
Giant cane	*Arundo donax*
Hydrilla	*Hydrilla verticllata*
Jointed goatgrass	*Aegilops cylindrica*
Musk thistle	*Carduus nutans*
Parrotfeather	*Myriophyllum aquaticum*
Russian olive	*Elaeagnus angustifolia*
Saltcedar	*Tamarix spp.*
Siberian elm	*Ulmus pumila*
Tree of heaven	Ailanthus altissima

Watch List Species

Watch List species are species of concern in the state. These species have the potential to become problematic. More data is needed to determine if these species should be listed. When these species are encountered please document their location and contact appropriate authorities.

Common Name	Scientific Name
Crimson fountaingrass	*Pennisetum setaceum*
Meadow knapweed	*Centaurea pratensis*
Myrtle spurge	*Euphorbia myrsinites*
Pampas grass	*Cortaderia sellonana*
Sahara mustard	*Brassica tournefortii*
Syrian beancaper	*Zygophyllum fabago L.*
Wall rocket	*Diplotaxis tenuifolia*

From NMDA 2016

A **WEED REPORT** from the book *Weed Control in Natural Areas in the Western United States*

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Halogeton glomeratus (M. Bieb.) C.A. Meyer

Halogeton

Family: Chenopodiaceae
Range: Throughout the dry arid regions of the western U.S.
Habitat: Disturbed open sites, dry lakebeds, shrublands, roadsides, typically where native vegetation is sparse. Inhabits arid and semi-arid regions, especially where winters are cold. Primarily adapted to alkaline and saline soils.
Origin: Native to the cold desert regions of Eurasia.
Impacts: Plant tissues accumulate salts from lower soil horizons. The salts leach from dead plant material, increasing topsoil salinity and favoring halogeton seed germination and seedling establishment. The foliage contains variable amounts of soluble sodium oxalates and can be fatally toxic to livestock, especially sheep, when ingested in quantity. Impacts grazing capacity as animals generally avoid consuming the bitter-tasting foliage if more palatable forage is available. Caution should be exercised, however, when unloading hungry livestock onto halogeton-infested rangeland.
Western states listed as Noxious Weed: Arizona, California, Colorado, New Mexico, Oregon
California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness

Halogeton is an erect winter or summer annual to 1.5 ft tall, with small fleshy leaves. Stems are usually tinged reddish or purple and the leaves are alternate, sessile, dull green to bluish-green, with a stiff bristle tip.

The flower clusters are numerous and dense in most leaf axils. Flowers lack petals and produce one-seeded fruits (utricles) with the sepals forming a fan-shaped structure concealing the black or brown seeds. Plants reproduce only by seed, which are dispersed by seed-gathering ants, animals, and when dry plants break off at ground level and tumble with the wind. Many seeds survive ingestion by animals, including sheep and rabbits. Black seeds can imbibe water and germinate in less than 1 hour. Because seed form small coiled embryos in fruit, they do not persist long in the soil.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Because halogeton is a simple shallow-rooted annual, it can be controlled effectively by tillage or pulling. Plants are easiest to control as seedlings or in early vegetative growth. Plants not controlled until after flowering begins may contain seeds and should be removed and destroyed to prevent reseeding. Periodic mowing close to the soil surface can significantly reduce but not completely prevent seed production. Surviving branches below the reach of mower blades will continue to produce viable seeds. It is best to avoid increasing disturbance unless successful restoration of perennials is highly probable.

Cultural	Disturbances such as overgrazing and fire typically reduce desirable vegetation and increase open sites with bare soil. This can encourage invasion and establishment of halogeton. Any cultural control strategy should increase perennial vegetation, as halogeton has been shown to compete poorly with established perennial species. Grazing alone is not a control option because of the toxicity of the plant. However, timely grazing of desired vegetation has been shown to reduce halogeton spread. For example, halogeton in Nevada decreased under late spring to early summer (mid-April to mid-June) grazing at moderate intensity, compared to high intensity grazing in early spring (March to April). While fire can kill standing halogeton plants, fire disturbance often enhances seed germination and favors the growth of dense stands when the burns are not hot enough. In most cases, halogeton is one of the first plants to reestablish following wildfire on infested rangeland.
Biological	No biological control agents are available for the control of halogeton. A stem-boring moth (*Coleophora parthenica*) from Pakistan was released for halogeton control in the U.S. However, it failed to establish. Other potential biological control agents have been identified in Central Asia, but they have not yet been developed and tested.

CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	**Rate:** 2 to 6 pt product/acre for ester formulation (0.95 to 2.85 lb a.e./acre) **Timing:** Postemergence in early spring when plants are growing rapidly before bloom stage. **Remarks:** 2,4-D gives good, but not excellent, control and may damage desirable broadleaf natives, particularly at high rates. Reapplications are required to control subsequent germinants. Ester formulations are considered more effective than amine formulations. Apply with a crop oil concentrate for consistent control. Because of injury to native shrubs and a lack of desirable forage species adapted to alkali conditions, the use of 2,4-D for halogeton control has declined in recent years.
Aminocyclopyrachlor + chlorsulfuron *Perspective*	**Rate:** 3 to 4.5 oz product/acre **Timing:** Postemergence in early spring when plants are growing rapidly before bloom stage. **Remarks:** *Perspective* provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Little is known of the herbicide for halogeton control as its registration is relatively new. However, it has been shown to be very effective in herbicide trials. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
AROMATIC AMINO ACID INHIBITORS	
Glyphosate *Roundup, Accord XRT II,* and others	**Rate:** Spot treatment, 2% v/v solution *Roundup ProMax* **Timing:** Postemergence in summer before plants bloom. **Remarks:** Use as a spot treatment on small infestations. Repeat treatments are necessary to control flushes emerging later in the season.
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron *Telar*	**Rate:** Label recommends 0.5 to 1 oz product/acre (0.375 to 0.75 oz a.i./acre), but field results have shown 0.2 to 0.5 oz product/acre (0.15 to 0.375 oz a.i./acre) to be effective. Apply with surfactant. **Timing:** Postemergence in late spring or early summer when plants are only 1 to 3 inches tall. **Remarks:** Chlorsulfuron has been shown to be more effective than metsulfuron in western rangelands. Chlorsulfuron can damage some native shrubs, including Nuttall's saltbush (*Atriplex nuttallii*). Chlorsulfuron is considered the most effective herbicide for control of halogeton in

	rangelands.
Imazapic *Plateau*	**Rate:** 4 to 6 oz product/acre (1 to 1.5 oz a.e./acre) **Timing:** Preemergence or early postemergence to seedlings 1 to 3 inches tall. **Remarks:** For postemergence application, add a surfactant at about 1.5 oz/acre. Imazapic is selective to most native grasses, but will injure some species. Higher rates may suppress seedlings of some cool-season grasses. Imazapic is not registered for use in California.
Metsulfuron *Escort*	**Rate:** 0.5 to 1 oz product/acre (0.3 to 0.6 oz a.i./acre). Apply with surfactant. **Timing:** Postemergence in the late spring or early summer when seedlings have emerged and are growing rapidly, generally 1 to 3 inches tall. **Remarks:** Metsulfuron does not cause injury to grasses and this may be a desirable feature in areas with crested wheatgrass or other forage grasses. Metsulfuron is not registered for use in California.
PHOTOSYNTHETIC INHIBITORS	
Tebuthiuron *Spike 20P*	Tebuthiuron is a pelleted formulation that provides total vegetation control for several years and may be desirable for use on railroad ballast and oil field locations, where halogeton is often found. It has a very long soil residual activity and will provide total vegetation control for 3 to 5 years.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States.* Weed Research and Information Center, University of California. 544 pp.