St. Anthony Mine

United Nuclear Corporation

2022 Revegetation Plan Update

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List of Abbreviations

Best Management Practices	BMP's
Cedar Creek Associates, Inc.	Cedar Creek
Mining Act Reclamation Program	MARP
New Mexico Mining and Minerals Division	NMMMD
Post-Mining Land Use	PMLU
United Nuclear Corporation	UNC
Western Regional Climate Center	WRCC

United Nuclear Corporation (UNC)

St. Anthony Mine
2022 Updated Revegetation Plan

1.0 INTRODUCTION

Cedar Creek Associates, Inc. (Cedar Creek) was contracted in 2018 to update the Revegetation Plan in support of the "Closeout Plan" for United Nuclear Corporation (UNC) for the St. Anthony Mine. This updated Revegetation Plan is informed by previous vegetation sampling conducted in 2005, a growth media characterization effort and general site survey conducted in 2018 (Appendix A), and local and regional experience successfully reclaiming uranium sites with similar conditions and challenges. In general, this plan applies to lands within the project area that are subject to revegetation, including the waste piles, soil borrow areas, and revegetated portions of backfilled pits. Revegetation protocols and performance criteria presented in this plan are responsive to the rules, regulations, and guidelines of the New Mexico Mining and Minerals Division (NMMMD). Specifically, the 1996 Closeout Plan Guidelines provide a framework for the monitoring methodology and success criteria (NMMMD, 1996). This plan is also informed by three new guidelines released by NMMMD in 2021 and 2022, 1) Self-Sustaining Ecosystem Guidelines, 2) Guidance for Soil and Cover Material Handling and Suitability for Part 5 Existing Mines, and 3) Revegetation Guidelines for New and Existing Regular Mine Reclamation. This revegetation plan identifies and defines reclamation protocols (Section 2.0), monitoring methodology (Section 3.0), success criteria (Section 4.0), and contingency planning / corrective actions (Section 5.0) to be utilized for revegetation of the St. Anthony Mine.

In consideration of the Self-Sustaining Ecosystem Guidelines, revegetation planning will consider: 1) local vegetation communities, 2) post-mining (or post-disturbance) land use (PMLU), 3) specific considerations pursuant to desired post-disturbance management of private lands, and 4.) The most scientifically sound methods and state-of-the-art techniques related to revegetation, soil amendments, seedbed preparation, seeding, mulching, and general reclamation science. In addition, quality assurance and quality control procedures in the form of monitoring surveys will be undertaken to confirm that revegetation efforts are implemented correctly, and the results of the process meet predetermined success criteria. The goal of this planning is to reclaim disturbed areas within the reclamation area to a condition that allows for the re-establishment of a self-sustaining ecosystem on the permit area following closure, appropriate for the life zone of the surrounding areas unless conflicting with the approved post-mining land use. The process of monitoring and evaluation will also allow for an adaptive management approach to reclamation, further assuring a positive project outcome at the St. Anthony Mine Site.

1.1 Regulatory Guidance

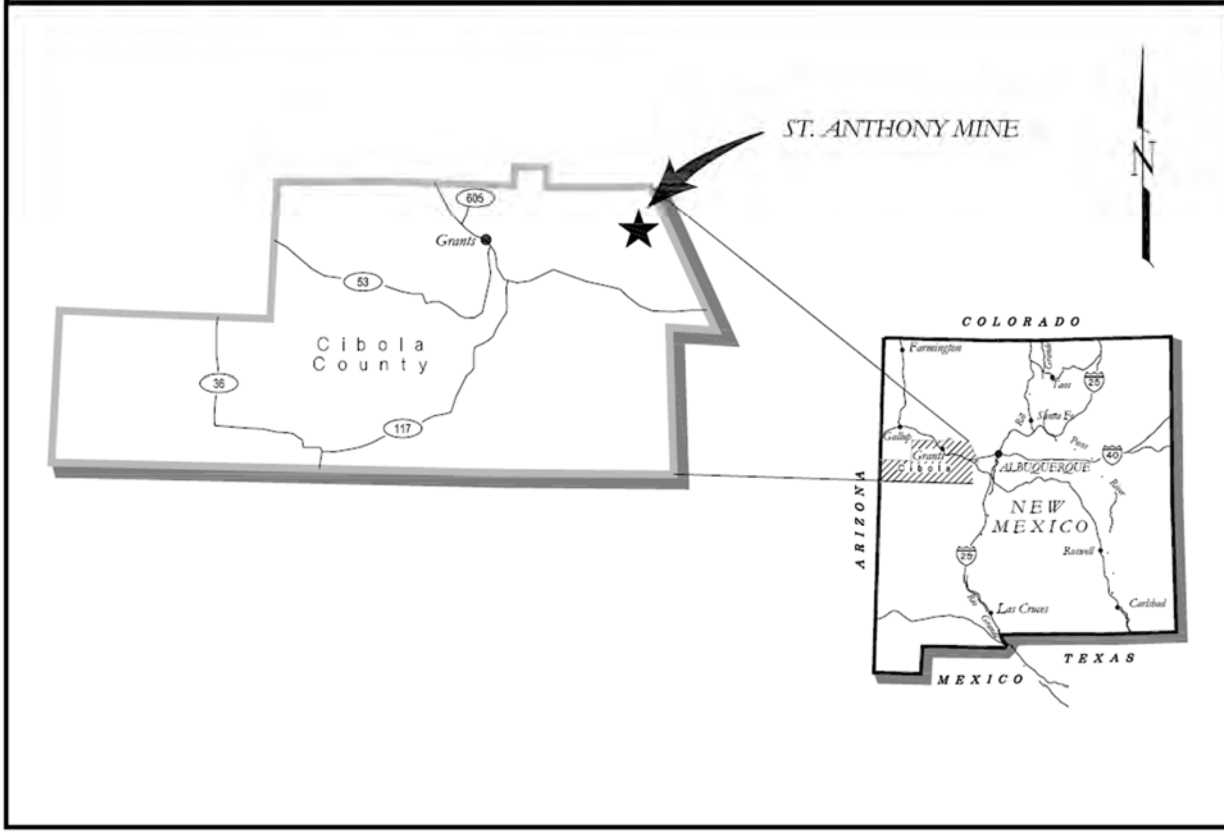
A basic framework for all reclamation including soil/growth media considerations, seeding considerations, and proposed amendments can be established for the entirety of the project. Site-specific considerations in addition to this framework can be applied or adjusted in the future to meet site-specific requirements. Industry best management practices (BMP's) will be employed wherever possible to increase the likelihood of positive project outcomes.

The St. Anthony Mine existed prior to the state Mining Act Reclamation Program (MARP), which regulates hard rock mining reclamation activities for uranium properties. Regardless, the revegetation protocols and performance criteria for the St. Anthony Mine Site will be guided by, and aim to meet the standards, rules and regulations of the NMMMD (New Mexico Administrative Code [NMAC] 19.10.5). New Mexico Closeout Plan Guidelines (NMMMD, 1996) provide a framework for the revegetation protocols and performance criteria to be applied to the St. Anthony Mine. Three new guidelines released by NMMMD in 2021 and 2022, 1) Self-Sustaining Ecosystem Guidelines, 2) Guidance for Soil and Cover Material Handling and Suitability for Part 5 Existing Mines, and 3) Revegetation Guidelines for New and Existing Regular Mine Reclamation will inform this plan.

1.2 Project Location

The St. Anthony Mine is located approximately 40 miles West of Albuquerque and 10 miles east-northeast of the town of Paguate, in Cibola County, New Mexico (Map 1). The project is located in the USGS 7.5-minute Moquino, New Mexico quadrangle, within the Arroyo de Valle, and is immediately north and east of Gavilan mesa. The former mine site exhibits a disturbance area of about 430 acres.

Map 1 - St. Anthony Mine - Project Location



1.3 General Site Description

The majority of the former mine site lies within an upland valley of floodplains, alluvial fans, and fan remnants dominated by grasses with occasional shrubs. The mine facilities (former pits, ancillary disturbances, several waste piles, and material storage piles) are located in this wide valley, predominantly consisting of fine textured Quaternary alluvium, ranging from approximately 5 to 50 feet in depth. The center of the valley contains an intermittent/ephemeral arroyo with finer, salty soils, supporting tamarisk and other weedy species, along with salt tolerant grasses. Sandstone benches and escarpments, with often shallow and lithic soils, are exposed on the margins of the main alluvial valley, increasing in prominence moving outward to the periphery of the project area. Transitions between these communities are often abrupt, as the vegetation systems are responsive to the soil systems and local geomorphology. Three vegetation ecotypes that correlate well with the soil-landscape relationship have been identified to dominate both the project site, and the life zone surrounding the project: 1) Grassland ecotype 2) Juniper Scrub ecotype, and 3) Bottomland ecotype.

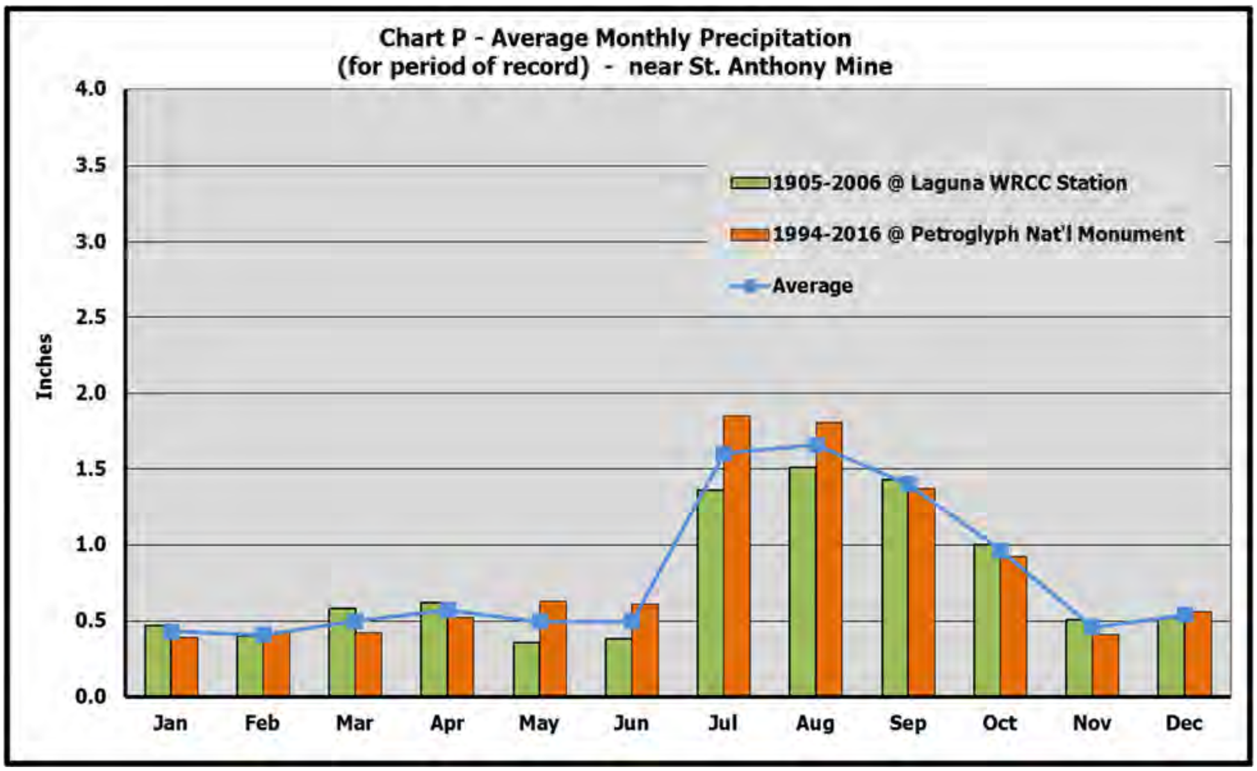
Grasslands are herbaceous communities dominated by grasses and occasional forbs that can sometimes be seasonally dominant. Trees and larger shrubs are largely absent from this type except for the occasional invader of local sites. Grasslands in this part of New Mexico may be dominated by annual grasses, perennial bunchgrasses, or perennial sod-forming grasses and typically of the warm-season group. In the project area the grasslands are of this latter warm-season perennial sod-forming group. Soils tend to be deep (greater than 6 feet) but are occasionally shallow. Typical geomorphic features are floodplains, alluvial fans, and fan remnants.

The Juniper scrub ranges between a "savanna" of scattered trees within the benched high-plains grassland, to dense woody dominated areas with very poor herbaceous understories. The Juniper Scrub ecotype is usually associated with rock outcroppings and thin, skeletal soils, often with a sandy texture. Occasional piñon are found throughout the ecotype.

The Bottomland ecotype is primarily characterized as having higher available water within the soil profile (more loamy, less sandy). Also, the higher available water is due to the ecotype being physically located in the arroyo bottoms that tend to collect surface runoff and fine-textured erodible materials. The increased soil moisture and loamy texture leads to increased vegetative cover from herbaceous taxa. Visible salt crusts were noted within the drainage bottom and along the cut banks (Cedar Creek, 2018 attached as Appendix A). The arroyo is deeply incised, and the upland grasslands immediately adjacent to the arroyo are not subject to flooding from typical precipitation events. On occasion, the bottomland community can exhibit areas of shrub domination by four-wing saltbush in areas exhibiting moderately elevated salt accumulations but can also exhibit areas of dominance by winterfat or Bigelow's sagebrush. Other areas may be nearly absent of shrubs whereby grasses (and rarely forbs) are dominant. Tamarisk and other noxious weeds were also noted in the drainage bottoms.

1.4 Climate Data

The closest available weather stations to the project site, with prolonged and reliable climate data, are located in Laguna (~10 Miles to the southwest) and at Petroglyph National Monument (~33 miles to the east). The Laguna Western Regional Climate Center (WRCC) station period of record dates from April 1905 to March 2006, where average precipitation measures approximately 9.66 inches per year. The Petroglyph National Monument WRCC station period of record dates from April 1994 to May 2016, where average precipitation measures approximately 9.61 inches per year. The general agreement between these two data sets suggests the Petroglyph national monument site could be applicable to evaluating rainfall at the site in any given year during the reclamation process. Chart P below displays the average monthly data from each site, and averaged between sites, over the respective periods of record.



2.0 REVEGETATION PROTOCOLS

2.1 Growth Medium Considerations and Reapplication Depths

Once waste rock piles and other mine facilities have been graded to final contour, they must be top-dressed with an adequate amount of growth media. The growth media will be applied to develop an acceptable profile conducive to revegetation establishment and sustainability. A growth media characterization study was completed in 2018 (Appendix A), pertaining to the suitability of several soil Borrow Areas, Topsoil Piles, and Waste Piles for use as growth media and/or subsoil rooting media in the reclamation of the St. Anthony Mine Site. The study details the challenging soil chemical and physical properties that exist across the project area and provides recommendations that have been incorporated into several sections of this work plan. Soils in the project area generally have elevated levels of salts and high proportions of sand, which will exacerbate drought stress and erosion potential, but are suitable for use in reclamation through the use of BMP's and a risk-based approach to reclamation. A variety of BMP's (seeding, mulching, slope design, etc.) and conservative reclamation design elements will be implemented to ensure the likelihood of reclamation success.

The laboratory testing parameters, methodologies, and suitability criteria utilized in the growth media characterization study to inform this reclamation plan are presented below in Table 1. These suitability criteria are generally in agreement with the Soil and Topsoil Suitability Ratings of the NMMMD Closeout Plan Guidelines and the more detailed Guidance for Soil and Cover Material Handling and Suitability for Part 5 Existing Mines.

Table 1 St. Anthony Mine - Reclamation Plan - 2018

Soil Laboratory Results - Suitability Criteria

Paramater	Method	Acceptable Average Values	Units
pH (paste)	ASTM D4972 - 13	6 - 8.3	N/A
Electrical Conductivity	4F1a1a1*	< 3 < 6	mmhos/cm
Organic Matter	Walkley-Black	< 10	% of Total Soil
NO_3-N	4D6*	> 0.1+	ppm
Phosphorus (P)	4D6*	> 1+	ppm
Potassium (K)	4D6*	> 20+	ppm
Zinc (Zn)	4D6*	> 0.25+	ppm
Iron (Fe)	4D6*	> 1.0+	ppm
Manganese (Mn)	4D6*	> 0.1+	ppm
Copper (Cu)	4D6*	> 0.1+	ppm
Calcium (Ca)	EPA Method 3050B	Addressed as SAR	ppm
Magnesium (Mg)	EPA Method 3050B	Addressed as SAR	ppm
Sodium (Na)	EPA Method 3050B	Addressed as SAR	ppm
Sodium Adsorption Ratio	EPA Method 3050B	< 15	N/A
Texture by hydrometer	ASTM D422-63(2007)e2	No Textural Extremes	% Size Fraction

* Soil Survey 2014 as Reference + Values Can Be Increased Through OM Additions

Based on the results of laboratory analysis, soils and growth media Borrow Areas have been ranked by preference for use as a surficial reclamation planting and growth media, and appropriate cover depths have been suggested for each borrow source (Table 2). Both the quality of the borrow sources that will be utilized as cover materials, and the quality of the typical underlying waste materials, were considered when recommending cover depth requirements. The erodibility and generally elevated salinity in both surficial growth media, and especially in the underlying rooting media, were significant factors when suggesting minimum 24-inch cover depths.

Reclamation of Pit 1 entails partially backfilling the pit with waste rock from nearby waste rock dumps followed by material from the pit highwall. The resulting Pit 1 floor will be contoured to collect surface water within a low-lying depression. Similar to the reclamation of other facilities, growth media, to a minimum of 24 inches depth, will be placed on top of the partially backfilled pit bottom.

Results from all laboratory analysis of borehole samples from each borrow source and waste pile are available in Appendix A.

Table 2 St. Anthony Mine - Reclamation Plan - 2018
Growth Media Borrow Source Summary

Potential Growth Media Borrow Source	Rank by Preference	Placement Suitability	Recommended Minimum Thickness	Material Types Observed
North Topsoil Pile	1	Cover / Planting Media	24 inches	Topsoil
West Borrow	2	Cover / Planting Media	24 inches	Topsoil
				Alluvium
Lobo Tract	3	Cover / Planting Media	24 inches	Topsoil
				Alluvium
Borrow South	4	Cover / Planting Media	24 inches	Topsoil
				Alluvium
Topsoil / Overburden Pile	5	Cover / Planting Media (on < 10% slopes)	24-36 inches	Topsoil
				Alluvium
				Shale
		Subsoil / Rooting Media		Coal
				Gypsum Precipitates
South Topsoil Pile	6	Subsoil / Rooting Media	N / A	Topsoil
				Alluvium
				White Saline Sandstone
				Black Carbonaceous Sandstones
				Shale
				Coal

Handling of growth media should be done prudently as to avoid excessive disruption to soil structure. Handling or disturbance of growth media materials immediately following precipitation events should be avoided, when possible, to limit issues associated with compaction. During construction, final placement, seed bed preparation or amendment application, care should be taken to avoid unnecessary or repeated trafficking of growth media to limit compaction. If compaction is expected, deep ripping or chisel plowing should be implemented, and always on the contour.

2.2 Soil / Growth Media Amendments and Fertility

Nutrient levels within the proposed growth media borrow areas and topsoil piles are within the acceptable ranges (Appendix A), signifying fertility specific amendments are not required. However, when materials are disturbed (plowed, harvested, tilled), organic matter and associated fertility can be released (volatilized) by a subsequent increase in microbial activity. In addition, organic amendments, particularly fibrous composts, can increase the water holding capacity and general condition of the seedbed, particularly during the critical period of germination and plant establishment. Therefore, a general application rate of 2 tons/acre (dry weight) incorporated into 3 inches depth of composted cow manure, green manure, or composted biosolids will be applied, and will benefit establishing vegetation on all reclaimed facilities throughout the mine site, including the Pit 1 backfill.

If composted cow manure or biosolids are to be utilized, the moisture content, salinity, organic content, and radioactivity will need to be tested by a certified laboratory. All testing should be conducted on representative samples from the same batch intended for use on reclamation, as the composting industry is unregulated and material quality can vary. Moisture and organic matter are used to accurately calculate target application rates. Given the potential for elevated salts in the soils, only low salt amendments should be used. Composted biosolids will be tested to ensure sufficiently low radium activity concentrations prior to use. In specific instances, such as harvesting growth media from very deep in the soil profile or using material stockpiled for more than a year, increased quantities of manure may be beneficial, and will be addressed on an "as needed" basis.

Composted manures and/or composted biosolids are more desirable than inorganic fertilizers and industrial byproducts such as Biosol, because they are significantly lower in inorganic and total nitrogen. Nitrogen preferentially stimulates the growth of undesirable weedy annual species, which reduces available water and nutrients for desirable perennial vegetation. In addition to the low nitrogen levels, the physical structure of the compost increases localized water holding capacity and creates islands of fertility to aid germination. Plant germination and establishment in the first few years is critical, as native seed sources then begin to supplement the initial seeding and stabilize the soil medium. Organic amendment application should occur immediately prior to seeding, and be incorporated as soon as possible, preferably by disk harrow. Composted manure and/or biosolids left on the soil surface, exposed to warm temperatures and potential precipitation will readily decompose, thus making it less beneficial.

2.3 Erosion Control and Seedbed Preparation

Where possible, slopes should be kept at or under 25 percent (4:1) to increase the likelihood of a successful seeding effort and reduce the potential for erosion. The proposed growth media available onsite is primarily comprised of sandy soils; these soils are generally acceptable for vegetation growth but pose an elevated erosion risk (Cedar Creek, 2018). Therefore, where steeper slopes must be constructed, additional erosion control treatments (such as erosion matting, wattles, or rock/wood chip mulch) should be applied. On all sloping sites, reclamation techniques should be applied perpendicular to the direction of water flow as machinery access and safety considerations allow. Slope lengths should be broken by terraces such that no slope ever exceeds 400 feet uninterrupted and would be best if terraced at 100 or 200-foot length intervals.

Once the project area is regraded to approximate final configuration and overlaid with the native borrow material, areas of steeper slopes (4:1 or greater) should be deeply ripped, with a single or double-toothed chisel plow pulled by a D8 or equivalent dozer. Deep ripping must occur along the contour to a minimum depth of 12 inches to break the "slippage" zone between spoil materials and growth media and to create contour ridges to help preclude erosion. Ripping should occur at nominal intervals of 4 feet (but no more than 6 feet) between the ripper teeth.

A field level assessment of erosion risk should be implemented following construction to determine the appropriate temporary erosion control, if needed. The risk assessment should consider slope gradient, slope length, and contributing area. Areas with high consequences of erosion should receive permanent rock mulches and mixed into the growth media, or a combination of rock and wood shreds. Mulch can help conserve soil moisture for seed germination and aid initial plant establishment as well as provide additional soil erosion protection from both wind and water until a plant cover is established. Areas with lower consequences of erosion should receive certified weed-free wood shred mulch, wood chip mulch, or crimped straw mulch.

2.4 Seeding Considerations

Seed mixes are designed to facilitate growth of appropriate and sustainable species for the targeted reclamation community. Species proposed for this mix are suitable for use, as demonstrated by their establishment on nearby revegetation at the L-Bar Mine Site, and other uranium reclamation projects in similar soils and climates throughout the Grants Uranium Belt and rangelands surrounding Mount Taylor.

Based on the planned reclamation for the site, it is expected that 2 targeted revegetation communities will be established on the mine site. The upland revegetation community is expected to be targeted for most of the reclaimed mining facilities, including the majority of the Pit 1 backfill. This target community is completely reliant on precipitation to establish and persist on reclaimed mining facilities. Whereas the mesic community, which will be established in the low-lying areas of Pit 1 backfill where the surface water collects and infiltrates into the growth media, which is analogous to the Bottomland Vegetation Community found in the life zone of the project. Therefore, revegetation methods (mostly seed mix) shall be optimized to establish the appropriate mesic revegetation.

Effort will be made to implement seeding at optimal times for site conditions (late fall/early spring). However, if a unit must be seeded during inopportune months, a field level risk assessment will determine whether temporary erosion control measures (such as crimped hay, wood shreds, wattles, etc.) are needed to stabilize the surface prior to anticipated vegetation establishment. Seeding can be accomplished using both broadcasting and drilling techniques, following final contouring and compost application/incorporation. If seed is broadcast, a light disc harrowing perpendicular to the flow of energy (wind and/or water) should immediately follow seeding to increase seed to soil contact and provide some protection from wind or water erosion and granivory. If seed is drilled, drilling must occur on the contour, to create subtle ridges perpendicular to the flow of energy.

The proposed seed mixes are comprised of native species suitable for the local climate and edaphic conditions. Select species and application rates for each target revegetation community are presented on Tables 3 (Upland Target Community) and 4 (Mesic Target Community). Seed mixes have been designed to establish mixed shrub and grassland community, to provide for the PMLU of grazing and incidental wildlife habitat. Trees are not specifically targeted in the seed mix but are expected to gradually volunteer on reclamation (where site conditions allow) once the site stabilizes and natural successional processes commence. Volunteer vegetation (non-seeded species) are encouraged to establish on the revegetation parcel as long as species are not noxious weeds and do not impact the ability to achieve a sustainable perennial vegetative community.

Seed mixes will be obtained from reputable commercial sources and information regarding the percent purity, percent weed seed, and percent germination will be reported on the seed tag (a legal document describing the contents of the seed you are purchasing). Besides being very useful information to the consumer, state and federal laws require seed companies to provide a description of the seed being sold. The information on the tag comes from tests that have been performed on the seed by a seed testing laboratory.

Table 3 St. Anthony Mine - Reclamation Plan - 2022

Upland Seed Mix

No.	Obs. On Site	Common Name	Scientific Nomenclature	PLS/lb.** (Recommendations)	Recomd. PLS lbs/ac	PLS / ft²	% of Seeds in Mix	Comment (Based on Site-specific Findings or Professional Judgment) — This entire mix can be drill seeded
1	XX	Western wheatgrass	*Agropyron smithii*	110,000	1.50	3.8	4.4%	NRCS indicated climax species
2	XX	Alkali Sacaton	*Sporobolus airoides*	1,758,000	0.75	30.3	35.3%	NRCS indicated climax species
3	XX	Blue Grama	*Bouteloua gracilis*	825,000	0.50	9.5	11.0%	Stong component of native community
4	XX	Galleta	*Hiliaria jamesii*	159,000	0.50	1.8	2.1%	Stong component of native community
5		Thickspike Wheatgrass	*Agropyron dasystachyum*	154,000	1.00	3.5	4.1%	Good performer - Offers diversity
6	XX	Indian Ricegrass	*Oryzopsis hymenoides*	141,000	1.00	3.2	3.8%	Should do well in areas of sandy texture
7	XX	Sideoats Grama	*Bouteloua curtipendula*	191,000	1.00	4.4	5.1%	Good performer - Offers diversity
8	XX	Bottlebrush Squirreltail	*Sitanion hystrix*	192,000	0.25	1.1	1.3%	Fair performer - Offers diversity
			Subtotal		**6.50**	**57.6**	**67.1%**	
9	XX	Desert Globemallow	*Sphaeralcea ambigua*	500,000	0.75	8.6	10.0%	Sufficient performer for diversity
10		Palmer Penstemon	*Penstemon palmeri*	610,000	0.50	7.0	8.2%	Good performer - Offers diversity
11	XX	Rocky Mountain Penstemo	*Penstemon strictus*	592,000	0.25	3.4	4.0%	Fair performer - Offers diversity
12		Lewis Flax	*Linum lewisii*	293,000	1.00	6.7	7.8%	Good performer - Offers diversity
			Subtotal		**2.50**	**25.7**	**30.0%**	
13	XX	Fourwing Saltbush	*Atriplex canescens*	52,000	1.00	1.2	1.4%	NRCS indicated climax species - good forage value
14	XX	Winterfat	*Ceratoides lanata*	56,700	1.00	1.3	1.5%	Excellent performer - good forage value
			Subtotal		**2.00**	**2.5**	**2.9%**	
			Total		**11.00**	**85.8**		**This entire mix can be drill seeded**

Alternative species which may be used as substitutes for tertiary species or added to the overall mix for additional diversity.

Group	Obs. On Site	Common Name	Scientific Nomenclature	PLS/lb.	Recomd. PLS lbs/ac	PLS / ft²	% of Seeds in Mix	Comment
Grasses	XX	Sand Dropseed	*Sporobolus cryptandrus*	5,298,000	0.00	0.0		
Grasses		Arizona fescue	*Festuca arizonica*	550,000	0.00	0.0		Use in moist areas only, likes 14" of precip.
Grasses	XX	New Mexico Needlegrass	*Stipa neomexicana*	70,000	0.00	0.0		
Grasses	XX	Purple three-awn	*Aristida purpurea*	250,000	0.00	0.0		
Forbs		Small Burnet	*Sanguisorba minor*	55,000	0.00	0.0		
Shrubs		Wyoming Big Sagebrush	*Artemisia tridentata wyo.*	2,500,000	0.00	0.0		
Shrubs		Rubber Rabbitbrush	*Chrysothamnus naseousus*	400,000	0.00	0.0		
Shrubs		Black Sagebrush	*Artemisia nova*	907,200	0.00	0.0		

Primary Species - Should not be substituted.
Secondary Species - Substitute only when seed is not available. Substitutions should be: grass for grass, forb for forb, shrub for shrub.
Tertiary Species - May be substituted, but recommendation is to plant as indicated.

* The 11 lb/ac mix is designed for drill seeding. When broadcast and harrow methods are used, the rate should be increased 1.5 times. When hydroseeding methods are to be used, the rate should be doubled (2X). ** PLS = Pure Live Seed.

Table 4 St. Anthony Mine - Reclamation Plan - 2022

Mesic Seed Mix

No.	Obs. On Site	Common Name	Scientific Nomenclature	PLS/lb.**	Recomd. PLS lbs/ac	PLS / ft^2	% of Seeds in Mix	Comment (Based on Site-specific Findings or Professional Judgment)
				Recommendations				This entire mix can be drill seeded
1	XX	Western wheatgrass	*Agropyron smithii*	110,000	2.00	5.1	5.5%	NRCS indicated climax species
2	XX	Purple Three Awn	*Aristida purpurea*	250,000	0.50	2.9	3.1%	
3	XX	Alkali Sacaton	*Sporobolus airoides*	1,758,000	0.50	20.2	22.0%	NRCS indicated climax species
4	XX	Blue Grama	*Bouteloua gracilis*	825,000	1.00	18.9	20.6%	Stong component of native community
5	XX	Galleta	*Hiliaria jamesii*	159,000	3.00	11.0	11.9%	Stong component of native community
6		Thickspike Wheatgrass	*Agropyron dasystachyum*	154,000	1.00	3.5	3.8%	Good performer - Offers diversity
7	XX	Indian Ricegrass	*Oryzopsis hymenoides*	141,000	2.00	6.5	7.0%	Should do well in areas of sandy texture
8	XX	Sideoats Grama	*Bouteloua curtipendula*	191,000	2.00	8.8	9.5%	Good performer - Offers diversity
			Subtotal		**12.00**	**76.8**	**83.5%**	
9	XX	Rocky Mountain Penstemon	*Penstemon strictus*	592,000	0.25	3.4	3.7%	Fair performer - Offers diversity
10		Lewis Flax	*Linum lewisii*	293,000	1.00	6.7	7.3%	Good performer - Offers diversity
			Subtotal		**1.25**	**10.1**	**11.0%**	
11	XX	Fourwing Saltbush	*Atriplex canescens*	52,000	2.00	2.4	2.6%	NRCS indicated climax species - good forage value
12	XX	Winterfat	*Ceratoides lanata*	56,700	2.00	2.6	2.8%	Excellent performer - good forage value
			Subtotal		**4.00**	**5.0**	**5.4%**	
			Total		**17.25**	**91.9**		This entire mix can be drill seeded
Alternative species which may be used as substitutes for tertiary species or added to the overall mix for additional diversity.								
		Arizona fescue	*Festuca arizonica*	550,000	0.00	0.0		Use in moist areas only, likes 14" of precip.
	XX	New Mexico Needlegrass	*Stipa neomexicana*	70,000	0.00	0.0		
		Rubber Rabbitbrush	*Chrysothamnus naseousus*	400,000	0.00	0.0		

Primary Species - Should not be substituted.
Secondary Species - Substitute only when seed is not available. Substitutions should be: grass for grass, forb for forb, shrub for shrub.
Tertiary Species - May be substituted, but recommendation is to plant as indicated.

* The 17.25 lb/ac mix is designed for drill seeding. When broadcast and harrow methods are used, the rate should be increased 1.5 times. When hydroseeding methods are to be used, the rate should be doubled (2X). ** PLS = Pure Live Seed.

2.5 Noxious Weed Considerations

Prior to construction activities, listed noxious weed species found within the project area should be treated (chemically, mechanically, or biologically) to limit the spread of noxious weeds. Russian thistle is not a listed noxious weed in New Mexico (Witte, 2016) and is commonly found in the arid west where it decreases as perennial plant communities establish and disturbance diminishes. Russian thistle and other invasive annual species common to the area do not need to be treated.

3.0 VEGETATION SAMPLING METHODS

Methods set forth in this section conform to the new Revegetation Guidelines for New and Existing Regular Mine Reclamation. Vegetation sampling protocols involve an emphasis on ground cover to facilitate repeatable statistical comparisons among treatment areas (or unique revegetation units). Concentration on a single variable of plant ecology facilitates improved comprehension and comparability over time and among treatment scenarios. Ground cover data, especially when determined using a very precise method such as the point-intercept procedure, provides some of the most important information regarding community variability that ecologists can evaluate. Such data facilitate the determination of true species composition, relative health (condition), and successional status of the sampled area. Furthermore, the same data can be utilized to develop the "sister" variables of frequency and species composition if desired. In addition, strong inferences can be developed with other reasonably correlated variables such as production when species composition is factored into the analysis. Also, ground cover is a preferred variable for revegetation monitoring because cover data can be readily obtained in a statistically adequate and cost-effective manner (using the proper procedures), has broad application for evaluation (including erosion control modeling), precisely reflects species' dominance of a given area, and when collected using bias-free techniques such as the point-intercept procedure, is one of the most repeatable variables among independent observers.

Deficiencies in vegetation, both general and localized, and other pertinent information relative to the reclamation are also recorded while traversing monitoring units during vegetation evaluations. During these traverses, the observer is vigilant for: 1) areas of poor establishment/growth, 2) pervasively weak or stressed plants, 3) indicators of soil fertility problems, 4) noxious weeds or invasive plant infestation, 5) evidence of unintended livestock grazing, 6) excessive erosion, 7) pockets of the aforementioned, and 8) any other similar revegetation / reclamation related issues.

3.1 Sample Site Selection / Location

The primary field efforts call for sampling revegetation and corresponding reference area(s). The systematic procedure for the determination of sample locations occurs in the following stepwise manner.

1. A fixed point of reference is selected for the entire area to facilitate location of the systematic grid in the field.

2. A systematic grid of appropriate dimensions (i.e., 200 ft X 200 ft) is selected by Cedar Creek to provide a minimum number of coordinate intersections; reclaimed areas are conducted to a minimum of 20 (for areas greater than 1 acre) or 5 (for areas less than 1 acre) initial transects whereas reference area sampling is conducted to a minimum of 15 initial transects.

3. A scaled representation of the grid is overlain on field maps extending parallel to major compass points to facilitate field location.
4. Unbiased placement of this grid is controlled by selection of two random numbers between 0 and 200 (used as coordinates).
5. Utilizing a handheld GPS, all of the initial sample points are located in the field.

3.2 Determination of Ground Cover

Ground cover at each sampling site is determined utilizing the point-intercept method (Bonham 1989) as illustrated on Figure 1. This method has been utilized for range studies for over eighty years; however, Cedar Creek utilizes state-of-the-art instrumentation that it has pioneered to facilitate much more rapid and accurate collection of data. Implementation of the technique for the sampling effort occurs as follows: First, a transect of 10 meters length is extended from the starting point of each sample site toward the direction of the next site to be sampled. Then, at each one-meter interval along the transect, a laser point bar is situated vertically above the ground surface, and a set of 10 readings recorded as to hits on vegetation (by species), litter, rock (greater than 2mm), or bare soil. Hits are determined at each meter interval by activating a battery of 10 specialized lasers situated along the bar at 10 centimeter intervals and recording the variable intercepted by each of the narrow (0.02 inch) focused beams (see Figure 1). In this manner, a total of 100 intercepts per transect are recorded resulting in 1 percent cover per intercept. The point-intercept procedure has been widely accepted in the scientific community as the protocol of choice for vegetation monitoring and is used extensively within the mining industry in connection with bond release determinations.

3.3 Determination of Woody Plant Density

At each sample site, a 2-meter wide by 50-meter long belt transect is established parallel to the ground cover transect and in the direction of the next sampling point (in a cardinal compass direction – Figure 1). Occasionally 4 x 25 meter transects are employed where distance between points necessitates shorter belts. Then within each belt, all woody plants (shrubs, trees, and succulents) are enumerated by species and age class. Determination of whether or not a plant could be counted depends on the location of its main stem or root collar where it exited the ground surface with regard to belt limits. Sample adequacy is determined for informational purposes only.

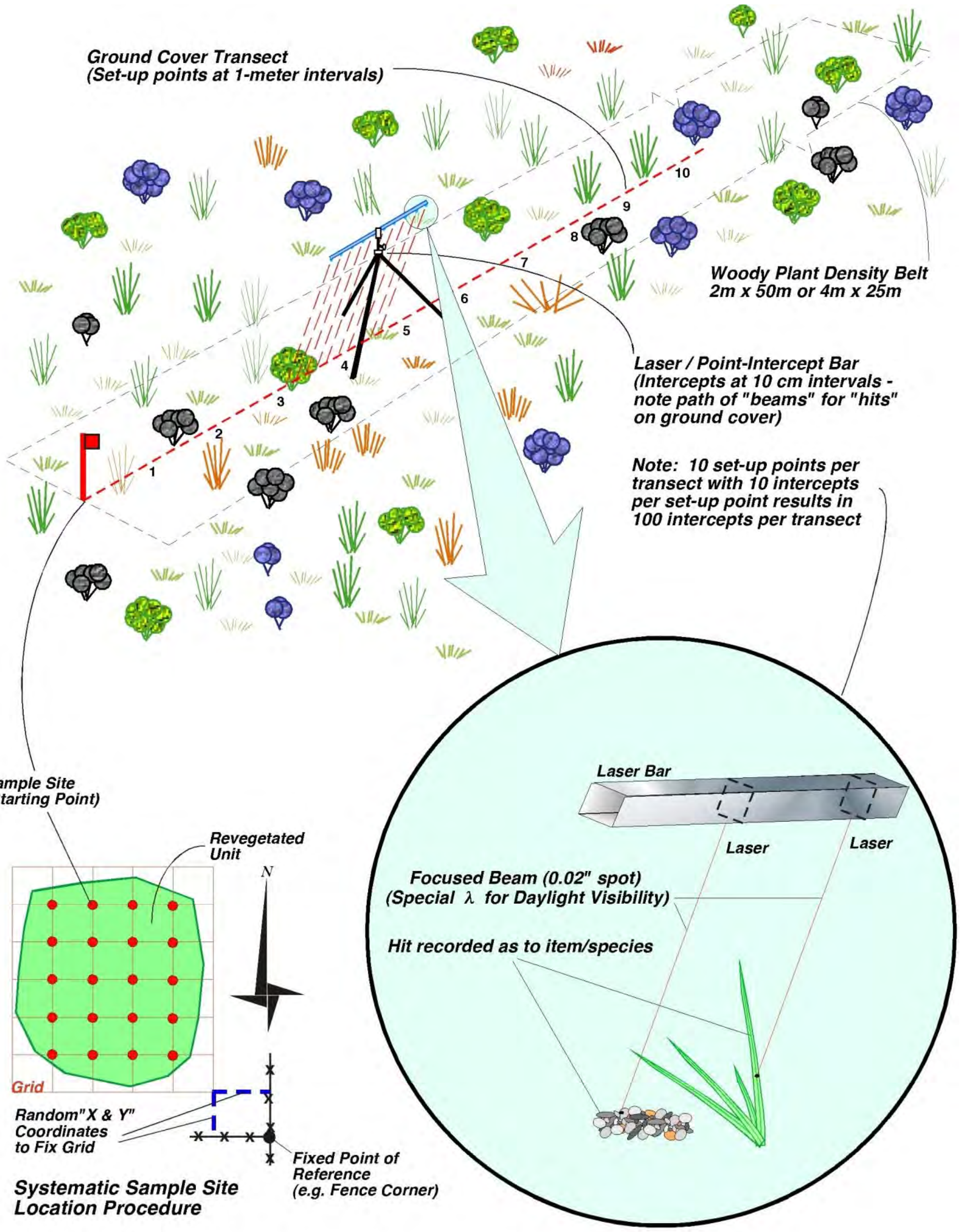


Figure 1

Sampling Procedure at a Systematic Sample Site Location

3.4 Photo Monitoring

Permanent photo-points (marked in the field with wood lathe and GPS coordinates) are established within revegetation areas to visually catalog vegetation progress. At each point, four photos are exposed, one each in a cardinal compass direction (N-E-S-W) using a photo board to indicate photo-point and direction visible in each frame. Photos are exposed in portrait orientation (as opposed to landscape) with the horizon at the very top of each photo. In this manner, all vegetation from very close to very far is observable. A map of the photo points will be provided in the revegetation monitoring reports.

3.5 Year 1 – Emergent Density Monitoring

Following the first growing season after seeding, each reclaimed unit is subjected to a relatively brief one-time evaluation to document plant establishment as well as record other pertinent reclamation considerations. This evaluation consists of a qualified observer traversing the reclamation areas and evaluating vegetation establishment and related physical and biotic conditions. Approximately 1 hour of review time per 20 acres is expended for qualitative efforts. During these traverses, the observer is vigilant for: 1) areas of poor seedling emergence, 2) pervasively weak or stressed seedlings, 3) indicators of soil fertility problems, 4) noxious weeds or invasive plant infestation, 5) evidence of unintended livestock grazing, 6) excessive erosion, 7) pockets of the aforementioned, and 8) any other similar revegetation / reclamation related issues.

In addition to the physical and biotic attributes evaluation, the surveying observer collects semi-quantitative samples to document the emergent density of seeded species. In this regard, between 5-15 samples are collected from each of the reclaimed units. Each sample consists of a cluster of five 1.0 ft^2 quadrats distributed in an unbiased manner. Following a random toss of each quadrat, the number of emergent plants rooted within the frame's perimeter is recorded accordingly into one of five classes: perennial grass, perennial forb, shrub/tree (by species), annual grass, or annual forb. This procedure typically takes only 2-3 minutes per sample point (five quadrats) yet yields valuable information on the success of the seeding effort. Typically, efforts that result in an average of fewer than one perennial emergent per ft^2 should be considered to be poor and a possible candidate for remediation. Efforts with 1 – 2 perennial emergents per ft^2 are considered to be fair, 2 - 3 perennial emergents per ft^2 are considered moderately good, 3 – 4 perennial emergents per ft^2 are considered to be good and 4 – 5 perennial emergents per ft^2 are considered to be very good. Finally, greater than five perennial emergents per ft^2 are considered to be excellent. Barring overly adverse events (grazing, drought, etc.), the number of observed emergents following the first growing season provides both an indication of the quality of eventual revegetation as well as the expected time necessary for the new community to reach maturity.

This semi-quantitative procedure is also implemented by Cedar Creek to provide perspective to an otherwise difficult visual circumstance. Because new seedlings are putting the vast majority of their energy into underground root systems during the first growing season, the above-ground plant parts are typically very small, obscure, and/or difficult to observe by the untrained eye. Because of this phenomenon, typical observation from a height of 5 - 6 feet (standing human) typically reveals only a small fraction of emergent plants. Oblique angle observation from a distance of more than 15 feet reveals almost zero discernible emergents.

4.0 REVEGETATION MONITORING SCHEDULE AND SUCCESS EVALUATIONS

The monitoring program and success criteria will follow the framework from the NMMMD. In this regard, a qualified revegetation specialist will review the revegetated areas on a pre-scheduled basis (during the peak of the growing season in September or shortly thereafter) to capture developing problems early in the process.

4.1 Revegetation Monitoring Schedule – NMMMD Framework

Under the NMMMD framework, the revegetation liability period (period of time that the owner is responsible for revegetation performance) is 12 years with monitoring every three years. The annual site visits for the revegetation will be as follows:

Year 1 – Emergent Density Evaluation

Year 3 – Qualitative and quantitative evaluations (managerial information only).

Year 6 – Qualitative and quantitative evaluations (managerial information only).

Year 9 – Qualitative and quantitative evaluations (managerial information only).

Year 11 – Qualitative and quantitative evaluations (final success evaluation).

Year 12 – Qualitative and quantitative evaluations (final success evaluation).

As indicated, the final efforts, during year 11 and 12, would be an evaluation for success determination. Years 11 and 12 information will be collected in such a manner as to provide defensible verification that success has been achieved. If it is determined that vegetation needs additional time to mature, monitoring will continue once every 3 years, thereafter, until success evaluations are positive. Other than first year efforts, annual monitoring would be a combination of both qualitative and quantitative efforts to facilitate tracking and progress toward revegetation success standards.

4.2 Revegetation Success Criteria

Success criteria will also generally follow the NMMMD framework. The determination of revegetation success will take into account the following four factors:

- Comparison will be to a representative reference area encompassing the adjacent vegetation community and/or desirable ecological conditions (for the variables of ground cover and diversity);
- Plant species from the approved (and planted) seed mixes are present on reclamation;
- Lifeforms found within the reference area are present on reclamation; and
- PMLU (e.g., livestock grazing with incidental wildlife habitat) has been established and the vegetation is capable of being grazed at proper grazing intensity.

A reference area will be utilized for revegetation success comparisons. Because disturbance occurred prior to baseline data collection, original delineations of unique vegetation communities are not available. Site surveys indicate the overwhelming majority of current disturbance and planned reclamation will occur within upland areas, with alluvial soils, within the broader alluvial valley. The areas surrounding planned reclamation are dominated by mixed native grasses with occasional shrubs, and represent the desired PMLU. Reclamation materials (both surficial growth media and subsoil rooting media) will be loose and fine, deep, and generally lacking of coarse fragments; these reclamation conditions will mimic the upland alluvial areas adjacent to reclamation units, and be most conducive to the establishment of mixed grass and shrub rangeland. A reference area or areas in close proximity (as appropriate) to the reclamation units, and representative of the edaphic conditions and PMLU of the reclamation system, will be proposed to NMMMD prior to revegetation sampling.

When utilizing reference areas (that are late seral by definition) for determinations of revegetation success, certain allowances must be made when comparing them to early seral revegetated communities; otherwise comparisons would be scientifically invalid. As such, precedent has been set in this regard in both the coal and hard-rock industry's reclamation regulatory mandates. These allowances are a reduction in the amount of ground cover and diversity from late-seral values.

Revegetation success in revegetated units targeting livestock grazing land uses with incidental wildlife habitats will concentrate on two performance standards: (1) vegetative ground cover, and 2) woody plant density. Therefore, revegetation efforts will be considered successful when the following criteria have been met following at least 12 years of growth and development.

1. <u>Vegetative Ground Cover Criterion:</u>

   The perennial vegetative ground cover (exclusive of listed noxious species) below breast height (1.25 meters) in the target revegetated unit equals or exceeds 70 percent of the extended reference area's perennial vegetative ground cover, with 90 percent statistical confidence.

   The success criterion was developed based on the NMMMD's precedents. The NMMMD has accepted 70% ground cover comparison on legacy mine sites which existed prior to the establishment of the MARP.

2. <u>Woody Plant Density Standard:</u>

   Woody plant density, as indicated by number of stems per acre in each revegetated unit equals or exceeds 60% of the stems per acre found in the reference area.

   OR

The density of live shrubs, sub-shrubs, trees, and woody cacti rooted within the boundaries of the revegetated unit equals or exceeds a success criterion of 200 plants per acre.

The success criterion was developed based on the NMMMD's precedents. The NMMMD has accepted 60% woody plant density comparison on legacy mine sites which existed prior to the establishment of the MARP. Additional information used to develop this success criterion is data from Hoenes and Bender (2012) for measured native shrub density on grassland communities of New Mexico with results of approximately 200 shrubs per acre on average.

4.3 Sample Adequacy Determination

Ground cover sampling within reclaimed areas is conducted to a minimum of 20 initial transects whereas reference area sampling is conducted to a minimum of 15 initial transects. From these preliminary efforts, sample means and standard deviations for total non-overlapping vegetation ground cover are calculated. The procedure is such that sampling continues until an adequate sample, n_{min}, has been collected in accordance with the Cochran formula (below) for determining sample adequacy, whereby the population is estimated to within 10% of the true mean (μ) with 90% confidence. These limits facilitate a very strong estimate of the target population.

When the inequality ($n_{min} \le n$) is true, sampling is adequate and nmin is determined as follows:

$$n_{min} = (t^2 s^2) / (d\bar{x})^2$$

where: n = the number of actual samples collected

t = the value from the one-tailed t distribution for 90% confidence with n-1 degrees of freedom

s^2 = the variance of the estimate as calculated from the initial samples

$\bar{x}$ = the mean of the estimate as calculated from the initial samples

If sampling is designed for a formal success evaluation and the initial samples do not provide a suitable estimate of the mean (i.e., had the inequality been false), additional samples will be collected until the inequality ($n_{min} \le n$) became true or until a maximum of 40 samples are collected. If sample adequacy is not achieved after 40 samples are collected, a reverse null approach will be used to demonstrate success. The demonstration of success will utilize the central limit theorem which assumes approximate normality when a sufficiently large number of samples are collected (greater than 30). A one-sided, one-sample, reverse-null t-test is considered appropriate. Since sampling adequacy is not required (nor recommended) for woody plant density, one density belt will be co-located with each ground cover transect, but adequacy shall not be tested for this variable. Resulting data can then be considered reasonable for the evaluation purposes intended.

5.0 CORRECTIVE ACTIONS / CONTINGENCY

After the initial seeding occurs and monitoring has begun, circumstances may require additional management actions to facilitate revegetation parcels toward the desired outcomes. The management actions presented below are normal land management activities. However, prior to implementing any remedial action, a plan will be submitted to NMMMD for approval. This plan will outline the issue(s) needing corrective action, proposed remedial activities, and a timeline for implementation. The list of remedial actions presented below may not represent an exhaustive list of potential options, as additional management alternatives may be needed to address site-specific issues that arise. Renegotiation of success criteria may be required if unforeseen circumstances occur.

5.1 Inter-Seeding

If undesirable precipitation, wind events, or any other factors contribute to poor seed germination, additional seed can be broadcast or drilled (if topography allows) into the required parcels as required without restarting the liability period.

5.2 Weed Control

Noxious weeds will be treated to allow desirable revegetation to establish. Best management practices will be employed on vehicles and work equipment to preclude the spread of noxious weeds.

5.3 Range Fencing

Range fencing, cattle guards, and gates should be installed around areas deemed necessary to exclude grazing livestock from revegetated areas. Grazing permittees will be notified that grazing of the revegetated area will not be permitted until approved by a qualified revegetation specialist (biologist or ecologist).

5.4 Mulching

If revegetation parcels are eroding at an unforeseen rate while vegetation is still establishing, mulch can be used to provide rainsplash and wind protection, reduce evaporation, and stabilize the seedbed. Preferably, a wood fiber or wood shred mulch would be used, as it is more robust than hay or straw and more likely to provide wind protection.

If used, wood fiber mulch or wood shred mulch will consist of specially prepared wood fibers and will not be produced from recycled material such as sawdust, paper, cardboard, or residue from pulp and paper plants. If necessary, such as on a steep slope or an area deemed a high wind erosion risk area, a tackifier can be used with the wood-fiber mulch to improve adhesion. If erosion areas are localized, small, or well-sheltered, simple straw mulch should suffice in providing rainsplash protection. Interseeding will most likely be necessary if erosion is sufficient enough to require post-revegetation corrective mulching.

5.5 Supplemental Irrigation

Supplemental irrigation is not considered a suitable treatment mitigation alternative for reclamation in the arid west, even in instances of extreme drought. Underperforming areas will be remediated using common techniques, such as reseeding and applying mulch or other amendments to improve vegetative growing conditions. Previous revegetation efforts in the region demonstrate that successful revegetation can be established without supplemental irrigation.

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