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Addendum 313A	Detailed Soil Use Balance *(located in Volume 1)*
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Appendix M	Bond Estimate *(located in a separate permit volume)*

RECLAMATION PLAN

(1) Description of Reclamation Operations

(a) Proposed Postmining Land Use

The postmining land uses will be Livestock Grazing Land, Wildlife Habitat, and Pastureland. These same uses were present before mining and are now the dominant land uses on adjacent lands. Some weedy premine areas (approximately 92 acres) were classed with special use pastures due to a prevalence of introduced species. All except 100 acres of the premine Pastureland will be reclaimed as Grazing Land with native seed mixes. In addition weedy premine vegetation will be revegetated as the next closest land use type of Grazing Land (See Table 313-6).

(b) Timetable for Completion of Each Major Step in the Reclamation Plan

In general wide latitude is required in the backfilling timeframe because Spring Creek operations create voids (especially final pits and ramp voids) that cannot be filled for 36 to 48 months when material becomes available. In addition Spring Creek Mine's (SCM's) coal quality constraints require multiple pit areas to be accessible to meet quality specifications. Plate 5 indicates SCM's mining sequence. The map indicates the time frames for mining sequencing between different pits.

Topsoil will be sampled and salvaged upon MDEQ approval in advance of the mining progression as described below. Regrading and sampling of overburden will be followed by topsoil application upon MDEQ approval. Recently topsoiled areas will be seeded as described in 17.24.313(h)(ii) below. Plate 6 indicates SCM's commitment to perform contemporaneous reclamation by showing the estimated locations of reclamation based on the backfill sequence. Projected areas of reclamation will vary; however, SCM will achieve the following reclamation acreages associated with permit renewal periods.

- 2015-2019 (205 acres)
- 2020-2024 (957 acres)
- 2025-2029 (1,110 acres)
- 2030-2034 (3,730 acres)

(c) Cost Estimate of Reclamation for Bonding

Please see Appendix M for the reclamation bond estimate. Appendix M is a stand-alone permit volume.

(d) Backfilling and Regrading Plan

(d)(i) Final Location of All Overburden Material

The final location of overburden material is shown on the Postmine Topography (PMT) Map (Plate 4).

Overburden rock strata removed during the coal stripping process will be spoiled in the pit following coal removal. Since no significant partings have been noted in exploration and developmental drilling or mining activities, parting material replacement is not anticipated.

A general description of spoil movement within the mine area is discussed below in Section 17.24.313(d)(v).

(d)(ii) Highwall Reduction and Material Burial

SCM will reclaim all highwalls developed during mining activities by backfilling with stockpiled overburden or other available spoil. (See Stripping Cross-section Map, Plate 15A, and PMT map, Plate 4.) Wherever coal seams are exposed in the final pit, that pit will be backfilled to cover all exposed coal seams with at least four feet of nontoxic, noncombustible fill material to prevent ignition of coal. Land above the highwalls will not be disturbed beyond the area of normal operations unless additional material is required to achieve approximate original contour. The highwall area and final pit will be completely backfilled with spoil (possibly through highwall reduction activities), and disturbed areas regraded, resoiled and revegetated. Backfilled areas will be regraded to slopes which approximate pre-mine slopes and which satisfy the post-mining land use. During backfilling and regrading procedures, backfilled material will be partially compacted by equipment operations.

Highwalls will be reduced by grading from beyond the top of the highwall and backfilling the final cut to achieve the slopes indicated on Plate 4, Volume 3. The slope will be blended to undisturbed ground in such a way that there is a smooth transition with the surrounding landscape.

HIGHWALL REDUCTION ALTERNATIVES

Highwalls may be left as steep slope features in the postmine topography to replace bluff features that existed before mining and to produce topographic diversity. A detailed comparison of the premine and postmine steep slope features is included in Volume 1B, 313 Addendum D. The text in this addendum also discusses the stability of such features in the postmine environment and the methods used for performing these assessments. Upon completion of regrade activities, the disturbed area is expected to resemble pre-mining slope conditions.

Where steep slopes and highwalls are left in place, SCM commits to meeting the performance standards in ARM 17.24.515.

Highwall reduction alternatives, i.e., bluff extensions and escarpments may be permitted where the Department determines that:

a. they are compatible with the post-mining land use (wildlife habitat enhancement feature for example);
b. they are stable, achieving a minimum static safety factor of 1.3;
c. similar geometry and function exists between pre- and postmining bluffs;
d. the horizontal linear extent of postmining bluffs does not exceed that of the premining condition; and
e. highwalls will be backfilled to the extent that the uppermost mineable coal seam is buried in accordance with ARM 17.24.505(1)

(d)(iii) Derivation of the Bulking (Swell) Factor

SCM completed a study of the overburden swell in July 2007. The study was accomplished using Carlson Survey 2004©, which utilized constructed mathematical grids of the premining surface in comparison with the surface existing in 2005 and 2006. Comparable volumes were computed for in situ volume removed versus spoil volume in place from the constructed grids. The overburden swell factor was calculated to be 16% for truck/shovel and 18% for dragline from this study.

(d)(iv) Postmine Topography

SCM considers spoil placement, original surface topography, and reclamation timeliness in the development of a postmine topography that meets the requirements of both approximate original contour (AOC) and contemporaneous reclamation. To that end, SCM commits to the following features in the postmine landscape to more closely approximate premining topography and improve establishment of vegetation communities. Ridges, drainages, slopes and general slope exposures are depicted on Plate 4. However, Plate 4 is an approximate template, which may not reflect potential improvements that can be made to more closely approximate original contours in the final regrade and do not depict detailed diversity features. The Department's Guideline for Determining Compliance with the Approved Postmine Topography recognize that, although premine conditions cannot be exactly obtained, postmine landscape features can be achieved even though they might not be depicted on the postmine topography map. Smaller and larger-scale landscape features can be incorporated into the postmine landscape to more closely approximate premine topography and to avoid long term geomorphic problems including long uniform slopes, inappropriate channel or slope profiles, or inadequate drainage density. As part of this ongoing effort, SCM will seek opportunities to construct regrade to more closely approximate premine drainage basin topography, longitudinal profiles and drainage bottom cross sections, as encouraged in the Department's AOC and PMT Guidelines. The features to be worked into the postmine landscape are as follows:

- Additional tributaries as appropriate;
- Over-steep slopes of various exposures in headwater locations;
- Incised tributary or dry wash areas;
- Complex side slopes;
- Small anomalies i.e. hog backs and knolls;
- Scoria outcrops; and,
- Others as approved by the Department.

These features will increase the resemblance to the general pre-mine surface configuration; they will blend in a way that will complement the surrounding landscape and terrain. All of the features will compliment postmine reclamation diversity for wildlife and vegetation, furthering the overall ecological function for the intended postmine land use. These features will provide the smaller and larger scale topographic diversity necessary for establishing a wide variety of ecological niches. The resultant postmine topography (PMT) is presented on Plate 4, Volume 3.

(d)(v) Demonstration that the PMT can be achieved

The initial step in designing the PMT is a projection of the mine's spoil placement coincidental with the extent of mining. Based on mining limits established by SCM, a pit shell was initially constructed to define the magnitude of the overburden and coal volumes for the remaining life-of-mine coal sequence

Modeling of the volumes was conducted with Carlson Survey 2008©, a surface modeling software package that operates within AutoCAD™. Individual surfaces were developed for top and bottom of coal and top of coal and original ground using geologic data and flight data. Additional surfaces were also constructed for overburden handled by the dragline (top of coal plus 160 feet) and truck/shovel overburden (original ground minus dragline surface areas). Carlson Survey 2008© converts surface mapping data into contours, grids, triangulated irregular networks (TIN) and triangulated grids.

Using surface-to-surface mathematical algorithms and pit boundaries from the life-of-mine sequencing, Carlson Survey 2008© provides material volumes for each component of the pit shell necessary to project the mine's spoil surface. Dragline spoils are modeled first using dragline modeling software referenced to the mine's operating parameters. (See Stripping Cross-section Map, Plate 15A, and PMT map, Plate 4.) Spoils placed in the mined pits are swelled by 16% for truck/shovel and 18% for dragline, and the pits are assumed to have experienced 95% coal recovery before spoil placement.

The approximate truck/shovel prestrip volumes are modeled next for placement on available dragline spoils to determine the location and approximate elevations for the PMT matched to available regraded areas. Truck/shovel box cut and prestrip overburden will be moved throughout the mine site between different pit areas, when necessary, to achieve contemporaneous reclamation (see Figure 313-A below). Approximate locations of boxcut, ramp cut-outs, or stockpiled overburden available for export to other pits is indicated on Plate 5 mining sequence. As a result of modeling the timing of prestrip and box cut material movement, several overburden stockpile locations were identified as deserving of special consideration. These piles are shown on Plate 5 and are discussed below.

Overburden Stockpile OB1-1:

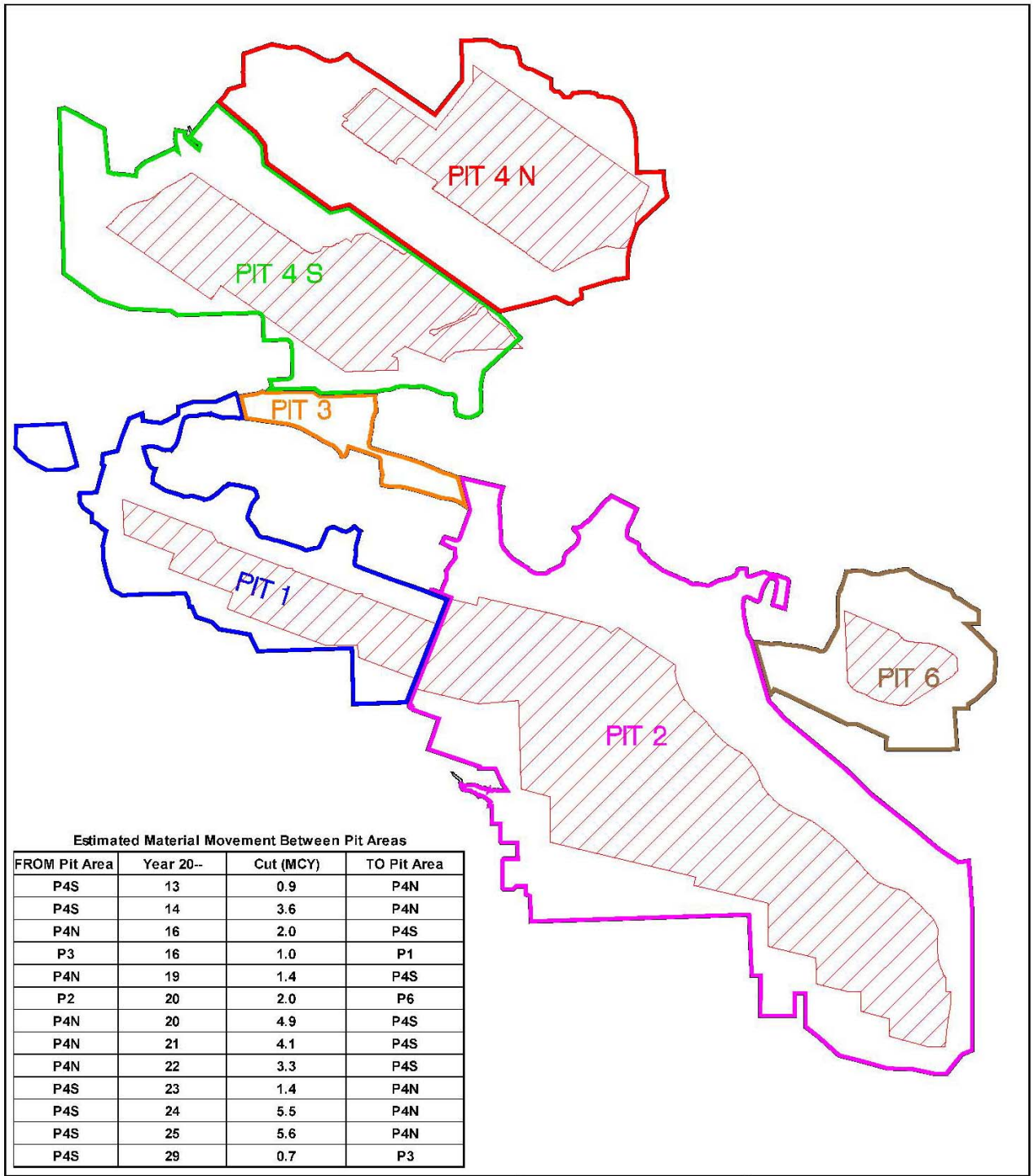
Because there is limited projected backfill area available in Pit 1, a temporary overburden stockpile is necessary. To avoid disturbing native ground an in pit overburden stockpile "known as OB1-1" will be located south of the South Fork Spring Creek in the Pit 2 area on backfill. The stockpile is necessary to meet AOC requirements during reclamation of the highwall feature that will remain at the end of mining in Pit 1. Approximately 3.3 million loose cubic yards (LCY) will be removed during prestripping in the western portion of Pit 1 and placed in this stockpile which is above PMT. The stockpile footprint is approximately 75 acres and prestrip will begin being placed in it in approximately 2016. The stockpile will result in a postponement of reclamation, within and surrounding the stockpile footprint, until the end of mining in Pit 1.

Overburden Stockpile OB1-2:

The stockpile "known as OB1-2" is located south of the South Fork Spring Creek in the western Pit 1 area on backfill and is necessary to meet AOC requirements during reclamation of the highwall feature remaining in the eastern portion of Pit 1. Approximately 11.7 million LCY will be removed during prestripping in the eastern portion of Pit 1 and placed in this stockpile. The stockpile footprint is approximately 130 acres and prestrip will begin being placed in it in 2014. The stockpile will result in a postponement of reclamation, within and surrounding the stockpile footprint, until the end of mining in Pit 1.

Overburden Stockpile OB2-1:

As Pit 2 advances south out of the South Fork of Spring Creek, prestrip increases until the ridge north of Pearson Creek is reached. Simultaneously the backfill topography of the South Fork



Estimated Material Movement Between Pit Areas

FROM Pit Area	Year 20--	Cut (MCY)	TO Pit Area
P4S	13	0.9	P4N
P4S	14	3.6	P4N
P4N	16	2.0	P4S
P3	16	1.0	P1
P4N	19	1.4	P4S
P2	20	2.0	P6
P4N	20	4.9	P4S
P4N	21	4.1	P4S
P4N	22	3.3	P4S
P4S	23	1.4	P4N
P4S	24	5.5	P4N
P4S	25	5.6	P4N
P4S	29	0.7	P3

Mining Areas

Mining Blocks (From Plate 5)

CLOUD PEAK ENERGY®

SPRING CREEK MINE

Figure 313-A
Prestrip and Boxcut Overburden
Hauled Between Pit Areas
September 2013

SCALE NTS FILE NUMBER Vol1_Fig313A_20200210_TR1MR232

drainage is shallow. As a result, final placement of backfill becomes an issue. Due to this, a temporary overburden stockpile "known as OB2-1 " will be constructed. This stockpile is located on the north side of the South Fork drainage and is used to reclaim the ridge between South Fork Spring Creek and Pearson Creek. The stockpile footprint is approximately 47 acres and will be reclaimed between 2026 and 2030.

Overburden Stockpile OB2-2:
As mentioned above, timing of truck shovel pre strip in Pit 2 requires temporary overburden stockpiles to be constructed. Therefore, a roughly 9 million LCY stockpile will be built north of Pearson Creek in Section 31 to best meet contemporaneous and AOC reclamation requirements. The stockpile "known as OB2-2" will also be used to reduce borrow south of the Pearson Creek drainage and meet AOC requirements in the final Pit 2 mine cuts backfill. Prestrip from Pit 2 will be used to construct the stockpile starting in 2020. The stockpile footprint is approximately 114 acres and will not delay reclamation, but will slightly accelerate otherwise planned disturbance, because it will be constructed on native ground.

Overburden Stockpile OB3-1:
An existing stockpile "known as OB3-1" will be used for reclaiming the ridge feature located between the South Fork Spring Creek and Spring Creek in Section 23 on backfill. Approximately 0.8 million LCY are currently in this stockpile which has a footprint of approximately 40 acres. The stockpile will result in a postponement of reclamation, within and surrounding the stockpile footprint, until the end of mining in Pit 4 cut P4E26.

Overburden Stockpiles OB4-1 & OB4-2:
Due to the divided mining sequence in Pit 4, temporary overburden stockpile room is necessary to avoid disturbing native ground for constructing additional out of pit overburden stockpiles. The stockpiles "known as OB4-1 and OB4-2" will be used to temporarily store truck shovel prestrip material before it will be used as backfill material. The stockpile footprints are approximately 70 acres and 25 acres and will result in a postponement of reclamation until the end of mining in Pit 4.

Overburden Stockpile OB4-3:
Mining in Pit 4 S at the end of mine life includes a highwall feature located in the southern portion of Section 15 and northern portion of Section 22. Borrow material will be utilized to the extent possible to reclaim this feature, however additional material will be required to meet AOC requirements. Approximately 14 million LCY will be removed during prestripping starting in 2015 and placed in this stockpile. The stockpile footprint is approximately 95 acres and will not delay reclamation, but will slightly accelerate otherwise planned disturbance, because it will be constructed on native ground, west of the final pit, and will not be reclaimed until end of mine life.

Overburden Stockpile OB4-4:
Mining in Pit 4 S at the end of mine life includes the pre mine ridge feature commonly referred to as "Heart Break Ridge". Approximately 10 million LCY will be removed from the south end of this ridge. Due to the lack of available borrow material a temporary in-pit overburden stockpile will utilized for the reestablishment of this end of the pre-mine ridge feature. The temporary overburden stockpile "known as OB4-4" will be used to construct this feature and meet AOC requirements. Prestrip from Pit 4 will be used to construct the stockpile starting in 2017. The stockpile footprint is approximately 130 acres and will be placed on backfill. The stockpile results in postponement of reclamation within the stockpile footprint until the end of mine life.

Overburden Stockpile OB4-5:

Sodium levels in Pit 4 require a divided mining sequence. As a result, coal mining is advanced in three separate pit areas (Pit 4 N and two areas in Pit 4 SE). For example, the SW portion of Pit 4 will advance before the SE portion. Pit 4 mining began in the Spring Creek drainage and has progressed north and south away from the drainage. In general truck/shovel prestripping increases as mining progresses north and south away from the drainage. Because of this and the divided mining sequence, nearby backfill areas are not always available to accept the prestrip material. Therefore, to avoid waiting for backfill room to become available (and conflict with contemporaneous reclamation requirements) the prestrip material from in Pit 4 South will be hauled north east past the final pit to an out of pit overburden stockpile "known as OB4-5". The stockpile footprint is approximately 56 acres and will not delay reclamation, but will slightly accelerate otherwise planned disturbance, because it will be constructed on native ground, north of the final pit.

Overburden Stockpiles OB6-1:

Mining in Pit 6 at the end of mine life includes a final pit to be reclaimed on the north side. The topography in this area includes two large hill features. Stockpile OB6-1 will be constructed to reclaim these hill features to meet AOC requirements. The stockpile is located immediately north of the Pit 6 area. Approximately 3.2 million LCY will be placed in this stockpile beginning in approximately 2016. The stockpile footprint is approximately 41 acres and will not delay reclamation, but will slightly accelerate otherwise planned disturbance, because it will be constructed on native ground, and will not be reclaimed until the end of mining in Pit 6.

In conjunction with the spoil projection work, design work was conducted to provide for surface drainage and to make smooth transitions to native ground at the pit limits as well as to previously reclaimed areas. The spoil projection surface is modified through numerous iterations to build a diverse topography that drains properly and provides suitable, stable landforms for the postmine land use.

After determining the general PMT contours, surface-to-surface modeling is conducted to ascertain the degree of borrow material required to construct the PMT as well as the general location(s) from which to retrieve the material. The PMT surface and borrow areas are incrementally adjusted using cut and fill balance polygons that have been analyzed for material balance using the Carlson Survey 2008© volume algorithms. This insures that the selected swelled cut volumes from the borrow area(s) matches the deficit requirement for constructing the PMT while allowing the final surface of borrow area(s) to be reclaimed for long-term stability.

An illustration of the material balance to achieve the PMT is presented in Table 313-1. The balance has been calculated by comparing grids (created using Carlson Survey 2008©) of the different surfaces. The actual borrow amount will be increased or decreased as necessary so that the amount of dirt required to construct the PMT is obtained.

Table 313-1. Mass Balance for Spring Creek Mine (Comparing 7/13 Topography to LOM with LBM Reserves)

	Bank Volume (CY)	Swell Factor	Swelled Volume (CY)
VOLUME AVAILABLE			
Coal Waste[1]	13,424,379	-	13,424,379
Dragline	544,687,057	1.18	642,730,727
Truck/Shovel	229,930,854	1.16	266,719,791
Borrow	56,374,169	1.16	65,394,036
Total Volume Available			988,268,933
BALANCE CALCULATIONS			
PMT Volume Required			985,831,870
Difference between PMT Volume and Volume Available			2,437,063
Balance			0.2%

[1]Coal waste projection is based on a 95% coal recovery rate.

SCM will notify the Department after detecting any grading problem that would result in noncompliance with the approved PMT map.

WILDLIFE ENHANCEMENTS

As part of its reclamation plan, SCM will, as opportunities arise, construct topographic/wildlife habitat features not depicted on the PMT map. These features will provide increased topographic and vegetational diversity and wildlife habitat similar to premine or undisturbed land nearby. Features modeled on nearby native sites will be constructed as part of the regrading process. All features will complement postmine land uses. Opportunities to construct wildlife enhancement features tend to be revealed in the field during rough regrade operations. SCM will inform the Department of the constructed features during the inspection process. Features will be included on the field map submitted with each annual report. Periodic updates of the PMT map (Plate 4) will include these features.

- Shrub mosaics – During the process of regrading, areas likely to accumulate snow will be used for increasing revegetation diversity by seeding shrubs.

- Wetlands – During the rough grading process opportunities for constructing wetlands may arise. Table 313-3 below indicates 3 acres of aquatic habitat will be disturbed during mine life. Spring Creek Mine will work with the MDEQ to permit wetland features more than one acre-foot and two feet deep. The wetland enhancement features will improve revegetation diversity.

- Rock Piles/Ledges - In the process of backfilling and grading, numerous large and durable rocks become available. Instead of trying to bury all of these rocks, some will be placed to provide habitat for wildlife.

- Cliffs – By leaving areas of highwall, wildlife habitat will be created in areas of competent rock. Cliffs will not be formed in backfill due to stability concerns. The cliffs will effectively provide similar habitat to what was present before mining.

- Steep Slopes/Escarpments - The mining process often results in areas with steep slopes and/or rough terrain. Leaving portions of these steep slope areas in place will create a more diverse topography and provide desirable habitat for different species of wildlife habitat than is associated with gentler slopes. Some of these areas may naturally have scoria substrates that would be left as the growth media without coversoil. These features also provide an opportunity for specific plantings or volunteer establishment of species that would not normally compete effectively with grasses on more productive substrates.

- Moisture Catchment Basins – Some areas that have been backfilled will settle and create small, shallow, water-holding basins. Other such features may be created during the regrade process. These sites will trap snow and runoff water to temporarily provide additional moisture for plants.

- Riparian Areas – Areas for riparian habitat will be created along stream channels. These riparian areas may include cutbanks and other features that promote habitation along streams and draws.

- Small Depressions - Native depressions are usually found along drainages or in upland areas, and similar areas are expected in reclamation. Depressions will act as moisture catchment basins and may hold water seasonally or yearlong. Upland small depressions will approximate premine size, distribution and terrain characteristics, with the largest no more than an acre in size and up to two feet deep, holding no more than one acre-foot of water unless otherwise approved by the Department

Small depressions in drainage bottom areas will be smaller, similar to natural features (e.g. relatively shallow approximately channel width pools. Drainage bottom depressions will generally form naturally in reclaimed drainage channels or floodplains. Where similar features are constructed, they will approximate premine habitat and characteristics consistent with drainage

reclamation requirements (e.g. ARM 17.24.634). These will generally be shallow incised features blending within an appropriate channel profile and cross section.

Small depressions in the post mine landscape will minimize erosion and conserve moisture. Depressions may provide seasonal wetland habitat, replacing or enhancing areas for wildlife and providing additional plant diversity and production. Depressions may be used seasonally by livestock, depending on water availability, and will have side slopes that allow easy access. The depressions will be compatible with the approved postmining land use and will not restrict normal access throughout the area or constitute a hazard.

Other, larger reclamation features, such as traps and sediment ponds converted to permanent ponds, larger depressions or larger upland playas, will be addressed under ARM 17.24.504, 642 and 751 (2) (f) and (g), as required, with Department approval prior to final reclamation.

Prior to soil salvage in some areas, it is necessary to clear away trees that are too large for stripping equipment. In some cases this woody debris may be placed on reclaimed areas for bird perches and small animal cover.

(e) Drainageway Reclamation Plan (PMT, Revegetation, and Hydrology)

The PMT map (Plate 4) depicts primary, secondary, and tertiary drainages within the disturbance limits. Drainageway configurations, both longitudinal and cross-section, mimic adjacent natural systems as shown on Plate J-2 in Appendix J.

Applicable drainageways will receive thicker coversoils than adjacent slopes and will be seeded with the approved alluvial seed mix (Seed Mixes 10 and 10b). Other than runoff from nearby reclaimed slopes, the hydrology of ephemeral drainageways will not achieve their full potential flows until they tie into their upstream counterparts and assume natural ephemeral flows.

(e)(i) Comparison of Premining and Postmining Drainage Basins

Drainages traversing portions of the backfilled final pit area will be reconstructed similar to premining conditions to the extent possible. Please see Appendix J for additional discussion on drainage construction. Premining and postmining drainage basin statistics are included on Plates 4B and 4, respectively. The reconstructed drainages will be built using suitable substrates and will tie into native drainages and swales (see PMT map, Plate 4). In consultation with MDEQ, placement of erosive materials (or other suitable substrate materials) will be allowed to mimic known or documented similar pre-mine conditions. Alluvial soils will be replaced in major drainages.

(e)(ii) Requirements within Drainage Basins

All major drainage designs will be submitted to the Department as discussed in Appendix J. In general, drainages will conform to these specifications:

a) Concave longitudinal profile.
b) Conformation to the approved PMT before topsoiling.
c) Use approximate premine drainage characteristics, where relevant.
d) Conform to the design criteria and tables in Appendix J.

SCM agrees to reconstruct all major ephemeral channels within the disturbed mine area using the best technology currently available (BTCA) at the time of reconstruction. SCM will meet performance standards in Section 17.24.634 and adhere to requirements outlined in Section 17.24.314. SCM will also meet all requirements of 82-4-231(10)(k), MCA and ARM 17.24.314 where the postmining topography differs from the premining topography.

(f) Drainage Channel Designs

Drainage channels will be designed to prevent material damage to the hydrologic balance in the adjacent area and to meet performance standards outlined in Section 17.24.634. First, second and third order minor channels will be constructed as discussed in Appendix J.

(f)(i) Detailed Drainage Designs for Channels Not Already Addressed

Detailed drainage designs will be submitted for channels that contain critical hydrologic, ecologic, or land use functions not already addressed in this rule such as alluvial valley floors, wetlands, steep erosive upland drainages, drainages named on USGS topographic maps, major channels or intermittent or perennial streams. Fluvial and geomorphic characteristics pertinent to the specific drainages being addressed will be included on the detailed drainage design.

(f)(ii) Designs for Other Channels

For all other channels, typical designs and discussions will be submitted for general fluvial and geomorphic habit, pattern, and other relevant functional characteristics.

(g) Plan for Removal, Storage, and Redistribution of Soil and Other Material

Details are presented in this Section and Sections 17.24.501 (general backfilling and grading), 502(cut and fill terraces), 503(small depressions, see also 17.313(1)(d)(iv)), 504(permanent impoundments (see also 17.313(1)(d)(iv) of this permit), 505 (burial and treatment of waste), 507(storage/disposal of garbage), 510(disposal of off-site waste, fly ash), 515(highwall reduction), 516(adjacent operations), 517(slides and other damage), 518(buffer zones), 519(monitoring for settlement), 520(excess spoil), 521(temporary cessation of operations), 522(permanent cessation of operations), 701(removal of soil moved to 17.24.313(1)(g)(ii)), 702(redistribution/stockpiling of soil moved to 17.24.313(1)(g)(iii), and 703(soil substitutes moved to 17.24.313(1)(g)(ii)).

(g)(i) Using Coal/Overburden to Develop Reclamation Plans.

Coal. Coal volume removed in conjunction with in situ spoil volume and the swelling factor (Section 17.24.313(1)(d)(iii)) are used for material balance (Table 313-1) and PMT construction. Coal operations are discussed in Sections 17.24.304(1)(g)(i) (coal and overburden baseline), 17.24.308(1)(a) (operating plan), and 17.24.322 (geologic information and coal conservation plan).

Spoil. Spoil handling is discussed in Section 17.24.308. Overburden will be stored and placed subject to constraints imposed by the operations and reclamation plans (Sections 17.24.308 (operations plan), 313 (reclamation plan), and 501(general backfilling and grading)) and characteristics identified through the geologic investigation presented in Volume 2 of the EBS and Section 17.24.304(1)(g)(i) (baseline geology).

In some cases when material is moved by a truck method, overburden chip samples may be collected and analyzed. Results, where pertinent, will be incorporated into final placement planning.

Following final placement and recontouring of overburden, spoil material will be sampled as discussed in Section 17.24.313(h)(xi).

(g)(ii) Soil Salvage for Each Lift and Soil Mapping Unit

Prior to any surface disturbance by mining operation, and after the removal of vegetation that would interfere with soil removal and use, suitable soil will be removed as follows. Soil will be segregated by lift. Lift 1 will have a stripping depth of approximately six inches and will be composed of the A, E, and possibly upper B or C horizons; this material goes into A stockpiles. Lift 2 is deeper suitable salvage material that goes into B stockpiles.

Prior to mining disturbance, SCM conducted detailed soil surveys covering the area planned for mining and a significant surrounding area as described in 17.24.304(k). Before Permit SMP C1979012 approval (April 1979), a baseline soil survey was conducted to characterize soil component information (soil series) for the development of a plan to address this subpart of Section 17.24.313. This information was presented to MDEQ in Volume 2, Soils and Geology of the EBS. A soil survey for the South Fork expansion was completed during 1990. Results of this survey are found in the 1990 update to Appendix A, Soils. To address the proposed expansion of mining into Pit 4, a soil survey was initiated in this area during the fall of 1997 and completed in the spring of 1998. The results of this survey are found in Appendix A-1, Soils and Overburden Baseline, 1998 CAA. A soil survey for the Pearson Creek Amendment area was started in 2006 and completed in 2007. The results of this survey are located in Appendix A2, Soils and Overburden Baseline, Pearson Creek Amendment Area**.** Soil survey results are summarized under Section 17.24.304(k). These surveys, augmented by pre-salvage sampling, serve as the basis for the soil handling procedures used at the mine site.

Soil data collected during the 1979 (original), 1990 (South Fork), 1998 (Carbone), and 2006-7 (Pearson Creek) baseline surveys referenced above provided the basis for the soil budget and redistribution depth. Salvageable soil by lift is summarized in the following Addendum 313A.

In addition to the baseline information from the various soil surveys, SCM also samples topsoil prior to salvaging it. This procedure refines preliminary baseline findings and determines actual salvage depths. The procedures used during grid sampling are as follows:

A 250-foot grid pattern is marked by survey stakes throughout the area slated for soil removal to delineate soil quality sampling locations;

The grid is field adjusted, and samples are taken with a soil probe, bagged, labeled, and transported to a laboratory for analysis;

Laboratory analysis includes texture, pH, EC, SAR, saturation percentage, boron when EC exceeds 4.0, and percent coarse fragments for special (identified) soils;

Fertility of topsoil is considered adequate for native plant communities, so routine soil fertility testing has been eliminated with MDEQ approval.

Visible physical parameters (color, percent coarse fragments, etc.) are usually determined in the field;

A map of the sample locations, corresponding laboratory results, and suggested soil salvage depths are submitted to the MDEQ for approval;

After consultation with MDEQ concerning total salvage depths for each lift at each location, each stake on the 250-foot grid pattern is marked with the approved salvage depth. This information is used by the equipment operators as the basis for soil salvage operations. SCM may provide additional topsoil salvage stakes in increments smaller than 250-foot to assist equipment operators in areas where some additional guidance may be needed. These additional salvage stakes will be located based upon the topography, baseline soils information, and the results of the laboratory testing for adjacent topsoil samples.

Based upon results of the 250-foot grid sampling, all available suitable soil will be removed before any excavation, drilling for blasting, mining, or other surface disturbances. Where soil materials are determined suitable for salvage, a six-inch topsoil layer will be removed as the first lift. If sufficient regrade areas are not immediately available to allow soil redistribution, the soil will be stockpiled in a manner to protect it from erosion and contaminants that might lessen its capability to support vegetation. The first lift will be stockpiled separately from deeper salvage or directly placed in the manner most conducive to successful revegetation. SCM will remove, as the second lift, all remaining suitable subsoil capable of serving as suitable plant growth media to be stockpiled or directly placed on regrade areas.

Selectively handled substrates will be delineated and salvaged accordingly and stockpiled or directly hauled to locations so identified. Redistribution of selectively handled soils will follow established procedures with possible variations (slope, aspect, thickness, scoria, or suitable spoil surface) after consultation with the Department.

The volumes for topsoil stripping will be updated after actual volumes are determined by salvage operations. This information will be provided in Annual Mining Reports.

To reduce the potential for erosion that may cause air or water pollution, SCM will limit, when possible, the size of the area from which soil is to be removed at any one time. Undisturbed soils will be

protected to the extent possible from contamination and degradation and soil salvage operations will be conducted in a manner and at a time that minimizes erosion, contamination, degradation, compaction, and deterioration of the biological properties of the soil. SCM will take all measures necessary to control erosion of undisturbed soil.

Soil removal is not required for minor disturbances as defined in ARM 17.24.701(4).

Substituting other Materials for Soil from 17.24.703

(1) Scoria and suitable spoil can be used as a revegetation substrate to create shrub mosaics and as in situ substrates. In situ scoria refers to the native thicker scoria areas along highwalls used as borrow and for blending contours. These areas will be disturbed and revegetated as the final pit void is reclaimed. In general, scoria is encountered throughout the mining area and will be used as soil opportunistically. The Sodic Overburden Test Plots (SOBTP), as reported in several annual vegetation monitoring reports, have shown that suitable spoil can be a good substrate for some shrubs and warm-season grasses, and that scoria substrates can support a diverse if sparse array of species.

Suitable spoil, is an appropriate revegetation substrate for Seed Mix #16, which may be seeded with a rangeland drill or in two components with drill and broadcast seeders. The interseeding mix (Seed Mix #16a) may subsequently be broadcast, possibly in conjunction with light scarifications.

Scoria has proven to be a good big sagebrush substrate and is associated with high species diversity both in nature (GHF type) and in revegetation (SOBTP and shrub mosaics). Furthermore scoria should be receptive to repeated broadcast seedings without additional seedbed preparation. Preliminary data from the SOBTP indicate the thicker the scoria layer, the better the sagebrush establishment. Seed Mix #12 and Seed Mix #12a (interseedings) are specifically designed for scoria substrates. One foot of scoria over suitable spoil is a good substrate for shrubs and two feet or more is appropriate for conifers (Section 17.24.717 which has been relocated to Section 17.24.313(1)(h)(iii)). Properly prepared in situ scoria substrates (Section 17.24.313 (1)(h)(iii)**)** are expected to comprise the best substrate for conifers.

Past reclamation experience has shown scoria with too large of chunks and a lack of fines can inhibit vegetation establishment. SCM will work with the MDEQ staff to review revegetation success on scoria areas to determine if reseeding, disking, or crushing the larger chunks with a dozer for example is necessary to achieve a suitable plant growth substrate.

Soil substitutes may require fertilization based on fertility analysis (N, P, K) (Section 17.24.313 (1)(h)(xi)**)**. Fertilization with mineral N is anticipated in most cases.

Suitable spoil is the best medium available for the intended purpose, i.e., a particular type of shrub mosaic. Scoria of suitable particle size is the best growth medium for conifers and another type of shrub mosaic. Because the nature (i.e., particle size and gradation) of scoria encountered during mining varies widely, SCC is committed to ensuring the substrate is suitable for vegetation establishment when used in reclamation. If it is determined through vegetation monitoring data that a particular scoria substrate reclamation area is not trending toward meeting applicable vegetation establishment requirements, then SCC will implement corrective action(s)

which may include:

- Removal and/or replacement with a more suitable substrate;
- Amelioration of the scoria through amendment additions or mechanical means (e.g., dozer tracking) to achieve a more suitable gradation; or,
- Other means developed in consultation with MDEQ.

The targeted substrates associated with different topographic habitat components are listed in Table 313-4 below.

(2) Soil substitutes will be handled in accordance with 17.24.313(1)(g)(ii) and 17.24.313(1)(g)(iii)) where applicable.

(g)(iii) Salvageable Soil Volumes

Acreages and Volumes The following calculations are based, in part, on estimated salvageable depths from soil surveys. Before salvage, the actual depth of salvage is determined by sampling (above). Scoria or suitable spoil may be used as part of the surficial revegetation substrate, diminishing the requirement for coversoil.

Data used for the following calculations are in Addendum 313A. The proposed life of mine disturbance is 7,062 acres. Of this, 983 acres were reclaimed as of 12/12, leaving 6,055 acres to be reclaimed. Also the CBM/RR/DWC/AR (CBM = Coal Bed Methane Corridor, RR = Railroad Loop, DWC = Dragline Walk Corridor, AR= Access Road) area of 261 acres has been accounted for separately as shown in addendum 313-A (areas are assumed to balance within themselves). However, special commitments have been made for 188 (10+70+66+25+17 as shown on Addendum 313A) acres of alluvial restoration and 79 (6+38+35 as shown on Addendum 313A) acres of general drainage, so 5,527 is the base acreage for generic reclamation.

Total stockpiled Lift 1 material is 1,572,154 cy counting all Lift 1 (A) volumes (1,514,456 cy plus 57,698) in Addendum 313A. Total stockpiled Lift 2 material is 5,513,384 cy counting all Lift 2 (B) volumes (5,201,844 plus 311,540) in Addendum 313A.

As of 12/12 estimated unstripped volumes of Lift 1 and Lift 2 material are 2,077,257 cy and 4,256,679 cy, respectively. SCM has committed to using 743,211 cy of material for alluvial soil replacement on 188 acres and 253,749 cy of material for general soil replacement on 79 acres.

Total Lift 1 general material is 1,514,456 cy presently salvaged plus 1,961,191 cy presently unstripped minus 63,437 cy (0.5’ or 25% of the 2’ target depth for 253,749) committed to drainage reclamation for a total of 3,412,210 cy. For the base acreage of 5,527 acres, approximately 0.4 feet of Lift 1 soil is available as shown on Addendum 313A.

Total Lift 2 general material is 5,201,844 cy presently salvaged plus 3,788,569 cy presently unstripped minus 190,312 cy (1.5’ or 75% of the 2’ target depth for 253,749) committed to drainage reclamation for a total of 8,800,101 cy. For the base acreage of 5,527 acres, approximately 1.0 feet of Lift 2 soil is available as shown on Addendum 313A.

Soil substitutes including suitable spoil and scoria will play a role in all land uses except pastureland (Section 17.24.313(1)(h)(iii)). In addition, some steep terrain along the south edge of the disturbance area has an in situ scoria substrate that will be revegetated following seedbed preparation.

SCM researched the possibility of replacing the soil and suitable plant growth media within the reclaimed channel and floodplain of the South Fork with alluvium/colluvium salvaged from the area during soil salvage operations. SCM intends to replace alluvial soil within the South Fork channel to a depth as shown in Table 313-2a. The surrounding edges of the floodplain will blend to the adjacent soil depth. The reclaimed channel design for South Fork is discussed in detail in Appendix J.

MDEQ has determined that the portion of Spring Creek within the mine permit boundary is not an AVF.

Soil Stockpiling

Topsoil will be stored in stable areas within the permit boundary where it will be undisturbed. Topsoil stockpiles will be protected from excessive water or wind erosion that might cause waste or lessen the soil's capability to support vegetation. Soil loss prevention techniques will be applied on a case-by-case basis. Depending on location, topography and slope of stockpile, these techniques could include, but not be limited to, ring ditches/berms, silt fences (fabric/straw bale), disking on the contour or other appropriate methods. These measures will be maintained until suitable vegetation has been established on the stockpiles to prevent erosion or loss of soil. In addition, stockpiles will be protected from unnecessary compaction by limiting heavy equipment traffic over stockpiles. Unless approved by MDEQ, stockpiled topsoil will not be moved or otherwise disturbed until required for redistribution on a properly prepared, regraded area.

Inactive stockpiles (those not scheduled for use or to receive additional soil within one year) will be seeded with the temporary Seed Mix #14 listed at the conclusion of Section 17.24.313. Active stockpiles may be seeded with a cover crop of cereal grain.

Spoil Preparation

Regraded areas will be sampled and analyzed to determine the physiochemical nature of the surficial spoil material, before topsoil redistribution. SCM samples regraded spoils on a 170-foot-square grid pattern yielding an average of 1.5 samples per acre to determine spoil quality. At each location, samples from two depth intervals are collected (e.g., 0 to 15 inches and 15 to 30 inches, or 0 to 24 inches and 24 to 48 inches). These samples are sent to an independent laboratory for analysis. These were selected with MDEQ's advice. Sampling results from an independent laboratory are reviewed for compliance with MDEQ suitability guidelines. Parameters include pH, EC, SAR, saturation percentage, and texture. The data are then forwarded to the MDEQ with a sample location map and a request for approval to begin soil redistribution on the regraded surface.

Where spoil areas are graded to a MDEQ-approved postmining configuration and sampling confirms suitability, the regraded spoil surface will be ripped to an average depth of 18" to promote deep root penetration, prevent slippage, and to allow for immediate redistribution. Equipment used to rip regraded spoils includes the ripper shanks on the back of road graders and dozers and the V-ripper pulled behind the farm tractor. Which machine is used for ripping spoils will depend upon the characteristics of the spoil and equipment availability. All three pieces of equipment are capable of ripping to a depth of 24 inches.

Soil Redistribution

Regraded spoil will be topsoiled as rapidly as practicable to prevent harming or eroding the spoil. Topsoil will be applied as soon as practicable and seeded in the first appropriate season.

Cover thickness can be an important component of plant habitats. Table 313-2 shows the soil balance. At the Sodic Overburden Test Plots, for example, thicker scoria covers initially were related to higher sagebrush density. Where topsoil is placed over suitable spoil, the relation is weaker. Revegetation diversity will be enhanced by using different substrates (topsoil, scoria, and suitable spoil) during the reclamation process. Studying reclaimed substrates at the Rosebud Mine, Keck (1998, p. 60) found that, apart from unpredictable textural discontinuities both within the profile and across the landscape:

> Native soils at the Rosebud Mine vary in depth to underlying sedimentary rocks. Spoil beneath the replaced materials presents less of a barrier to water movement or root growth than the original predisturbance sedimentary rock. As a result, spoil must be considered as part of the soil profile. The mine soils, although varying in depth of salvaged material over spoil, are uniformly deep as a rooting medium.

Table 313-2 indicates a rough balance between salvageable soil volumes for both lifts and remaining reclamation acreage. Accounted for separately are 983 acres of existing reclamation as of 12/12. To the extent that scoria and suitable spoil are used for shrub mosaics in some land uses, more soil will be available for distribution elsewhere. There may also be some swelling of soil during removal and placement.

The outer edges of floodplains will blend into surrounding soil/revegetation types. In all cases, there will be at least four feet of suitable material (topsoil, scoria, and suitable spoil) at the surface.

Land uses and associated site factors are briefly summarized in Tables 5 and 6 of Addendum 313B.

Seedbed preparation is described in Section 17.24.313.1(h)(v) below.

Table 313-2. Mean Soil Replacement Quantity as of 12/12

SOIL	ACRES	Target Depth (ft)	Volume (Cu. Yards)
General	5,527	0.4	(Lift 1) 3,412,210
		1.1	(Lift 2) 8,800,101
[1]General Drainage	79	0.5	(Lift 1) 63,437
		1.5	(Lift 2) 190,312
Alluvial	188	Varies	743,211
Reclaimed	970	N/A	Placed
		N/A	Placed
[2]Reclaimed Alluvial	~ 13	N/A	Placed
	Total Volume Needed		13,209,220
	Total Volume Available		13,419,473

[1]CBM/RR/DWC/AR 261 acres accounted for separately.
[2]Some alluvial soil has been reclaimed as of 12/12 as described by Addendum 313A.

SCM will replace alluvial and general soil in major drainages as shown in Table 313-2a. The minimum and maximum values for the belt widths shown in the table are based on the guidelines for reconstructed channels in Appendix J. The calculations are based on a channel slope and drainage area, which were taken from Plate 4 and Plate J-5; respectively. Table 313-2a is a conservatively wide estimate for reclamation belt widths and actual designs for reclamation of major drainages will be submitted to MDEQ for approval prior to construction. However, this table demonstrates sufficient alluvial material will be available for reconstruction of the major drainages.

Table 313-2a. Major Drainage Alluvial Replacement and Typical Channel Dimensions

Stream Channel	Max Channel Slope %	Min Channel Slope %	Min Belt Width (ft)	Max Belt Width (ft)	Average Belt Width (ft)	2012 Un-reclaimed Channel \Length (ft)	Alluvial Replacement Depth (ft)	2012 Required Alluvial Replacement Volume LOM (cy)
Spring Creek	0.9	0.6	134	239	186.5	25,080	2	225,163[1]
North Fork Spring Creek	0.91	0.81	115	167	141	4,945	2	33,589[1]
South Fork Spring Creek	1.5	0.6	77	206	141.5	31,194	2	212,581[1]
Pearson Creek	2.1	1.13	41	93	67	16,321	4	162,001
South Fork Pearson Creek	1.3	0.9	55	135	95	7,807	4	109,876
							Total Needed =	534,240
							Total Available (See Addendum 313-A) =	549,270

All values reported are inside the SCM disturbance boundary.
[1]Based on 65% alluvial replacement width of the average belt width.
[2]Based on current reclamation and alluvial topsoil stockpiles as of 12/12 to include all of South Fork drainage alluvial topsoil recovery.

The outer edges of floodplains will blend into surrounding soil/revegetation types. In all cases, there will be at least four feet of suitable material (topsoil, scoria, and suitable spoil) at the surface.

Table 313-4 below describes land uses and targeted depths for redistribution of different substrates.

In situ scoria may be used without coversoil. Scoria and suitable spoil may be used in Wildlife Habitat land use areas or WHEFs without coversoil.

(g)(iv) Submission of Monitoring Plans

SCM will submit plans for any necessary monitoring of soils, overburden, spoils, or other materials. These monitoring plans are located as follows:

Monitoring Plan	Location
Overburden	17.24.304(g)(i) Volume 6 CSMRI of the EBS Report Appendix A-1 & A-2
Soils	17.24.313(g)(ii) Volume 2 of the EBS
Spoils	17.24.313(g)(i)

(h) Narrative of Revegetation

Postmine land use types are based on premine land uses. The revegetation plan is designed to achieve postmining land uses. The three land uses are:

Pastureland	Emphasis on livestock grazing and occasional haying. Low topographic positions, gentle slopes. Wildlife use is common although wildlife habitat enhancement features (WHEFs) are generally lacking due to conflicts with part of the primary land use, e.g., occasional haying.
Grazing Land	Primary emphasis on Livestock Grazing. Low to mid slope positions, gentle to moderate slopes. Use by a full array of wildlife is common.
Wildlife Habitat	Some areas of wildlife habitat provides for sage grouse and associated species on gentle slopes in lowlands. Other areas provide for mule deer and associated species on generally steeper slopes in uplands. Table 313-4 below associates topography with the targeted wildlife habitat.

In reclamation, SCM is creating habitats to support designated land uses. Grazing Land is a land use, but SCM actually is creating livestock habitat to support that use. The use of these habitats by both livestock and wildlife may not reach full potential until after the liability period due to grazing impracticalities caused by mining activities, field isolation, travel impediments, distance to a drinking-water source, or other temporary conditions.

Key elements of general cattle habitat are forage (grasses and when available legumes), proximity to a

source of drinking water, and rather gentle slopes. SCM is not attempting to create special livestock habitat such as calving grounds.

Wildlife Habitat entails more than how land is "dedicated" or "managed" (82-4-203 (20)**,** MCA). Any landscape or plant community will provide habitat for several or many animal species. Even though many species may use a habitat, the quality (attractiveness) of that habitat may vary drastically for different species. Some species may use a habitat intensively, whereas use by other species may be incidental. There is also a temporal element, e.g., winter habitat, fawning habitat, transient use, etc. Habitat can only be defined, created, and evaluated with specific species in mind, i.e., the ones for which that habitat is most important (Morrison 2002). The discussion in Addendum 313B provides additional information regarding the targeted Wildlife Habitat components.

In re-creating and improving upon premine land uses, SCM recognizes these important precepts:

- The need to match substrates and topography to land uses, including the use of soil substitutes to create shrub mosaics in areas of predominantly steppe vegetation (some grazing land) and in areas of shrub-steppe.
- The role of habitat diversity across the landscape to provide habitats for identified wildlife species in different seasons, times of day, etc. Habitat use in one land use can be enhanced by proximity to other land uses and physiognomic types.
- The need for a more temporal approach to revegetation as elaborated in (h)(ii) Schedule of Revegetation.

(h)(i) Revegetation Types and Acreage of Each

Major and minor seed mixes associated with each land use conclude this section. Table 313-3 below shows the pre and post mining acreages for each land use type. Table 313-4 below summarizes the post mining topography component, vegetation, substrate and projected acreages for each. The topographic habitat components shown on Plate 4A and in Table 313-4 will be used to provide a mosaic of wildlife habitat.

Table 313-3. Projected Post-mine & Premine Land Use Acreages Inside Disturbance Boundary

Land Use Map Unit	Life-of-Mine Reclaimed Area[1]				Pre-mine Projected Disturbance Area[2]	
	(Acres) Total Projected (LOM)	(Acres) As-built (2013)	Percentage of Total (%) Total Projected (LOM)	Percentage of Total (%) As-built (2013)	Acres	Percentage of Total
Grazing Land[3]	2,698	267	37.7%	3.7%	2,095	29.3%
Pastureland[4]	100		1.4%		703	9.8%
Wildlife Habitat[5,6,7]	4,355	811	60.9%	11.3%	4,355	60.9%
Total Land Use	**7,153**	**1,078**	**100.0%**	**15.1%**	**7,153**	**100.0%**
WHEF[8]						
Woody Plant Site	*140*	*10*		*0.1%*		
Rock Piles, Slash Piles		*43*		*0.6%*		
Seasonal Wetland		*12*		*0.2%*		
Ponds[9]	3	0	0.0%	0.0%	3	0.0%
TOTAL	**7,156**	**1,078**	**100.0%**	**15.1%**	**7,156**	**100.0%**

[1]See Plate 4A. LOM = Life of Mine, NA = Not Available. Total projected acreages combine as-built and future projections.

[2]Derived from Plate 23.

[3]As all pre mining lands were managed as Pastureland and Grazing Land per Environmental Baseline Studies, the remaining balance of acreage is applied to this land use type. The balance of 2,803 acres is determined by subtracting all other projected post-mine land use acreage from the currently projected total disturbance area of 7,062 acres. Grazing Land areas will contain 5 percent WHEFs. WHEFs are discussed in Section 313.

[4]No longer seeded per MR 08-12-09 as part of the mitigation required for Federal Lease Modification for MTM-69782, however, unintended areas may occur sporadically due to propagules of introduced perennial species persisting in the salvaged soil bank. Pastureland areas will contain 5 percent Wildlife Habitat Enhancement Features (WHEFs). WHEFs are discussed in Section 313.

[5]Federal Lease MTM-69782 was the original coal lease issued to SCM in 1965. The original lease did not stipulate a post mining land use of Wildlife Habitat. This lease was amended in 2000. The amended lease includes a letter from the MFWP to the BLM which states, "restore disturbed lands to their full potential as mule deer winter range", this statement affects 2,505 acres. The baseline inventory also identified 496 acres of woodland which is discussed in Section 313(1)(h)(iii).

[6]Federal Lease MTM-88405 (150 acres) was issued in 2001. The Environmental Assessment states, "land must be restored to the appropriate original contour and revegetated to restore mule deer and grouse habitat". Federal Lease MTM-94378 was issued in 2007. The Record of Decision states, "back to wildlife habitat as outlined in the reclamation requirements of state and federal mine permits". This statement affects 482 acres.

[7]Federal Lease MTM-69782 was modified in 2010 through a Lease by Modification (LBM). The LBM Record of Decision requires reclaiming 848 acres as Wildlife Habitat of which 108 acres will be disturbed by the Pearson Creek Permit Amendment and 740 acres by the major permit revision. State coal lease C-1088-05 was issued to SCM in 1965. Approximately 273 acres of this area has been recently designated as crucial sage-grouse habitat. As a result, the State who owns the surface, requires a post mining land use designation of Wildlife Habitat associated with the 273 acres. SCM is committed to reclaiming these 1,121 acres as sage-grouse habitat. Minor permit revision (IBC) 235 is an incidental boundary change includes disturbing 137 acres on the north side of Pit #4 for stockpile construction. This activity falls within general sage-grouse habitat as defined under the MT Sage Grouse Habitat Conservation Program because the application dates after January 1, 2016. The IBC includes 60 acres of flat Pastureland, which SCC has committing to revegetate as wildlife habitat to provide improved habitat for sage-grouse compared to pre mine conditions. MR 264 includes 37 acres designated as Sage-grouse Core Area per Map 3 of the SCM Annual Wildlife Monitoring Report.

[8]Wildlife Habitat Enhancement Features (WHEF) under 82-4-203(55), MCA are considered to be enhancement features incorporated with defined land uses occurring within the post-mine Grazing Land (82-4-203(22), MCA), and Pastureland (82-4-203(37), MCA) map units. As WHEF are not a land use, projected acreages are not given for each component; the target for post-mine WHEF is a minimum of 5 percent of total LOM reclamation within the Grazing Land and Pastureland units. **Note** that, with the exception of ponds, all WHEF acreages given are redundant with the primary land uses in which they occur, and for which they are managed, therefore are not added to the acreage total.

[9]Aquatic Habitats (ponds) are non-jurisdictional waters of the US as inventoried in Appendix L2. These areas are associated with pre-mine man-made ponds used for stockwater. The location of the postmining ponds will be designed and permitted with the MDEQ. The three acres of Aquatic Habitat will be incorporated into the reclamation plan as Wildlife Habitat Enhancement Features per 17.24.301 (143).

Table 313-4. below summarizes the post mining topography component, vegetation, substrate and projected acreages for each.

Revegetation Types ***(Post Mine Land Use)***	**Topographic Habitat Component**	**Vegetation Habitat Component**	**Substrate[1]**	**Targeted Seed Mix**	**Targeted Substrate Depth Range[2] (inches)**	**Targeted Wildlife Habitat**	**Projected Acreage[3]**
Grazing Land	Variable	Grassland Focus	Generic topsoil	13a, 13c, 13d, and 15	A = 2-6 B = 7-14	Variable Species using forage, cover, and WHEFs	2,698
Pasture-land	Variable	Introduced Grass Focus	Generic topsoil	N/A	A = 3-7 B = 10-17	Variable Species using forage, cover, and WHEFs	100
Wildlife Habitat	Steep north-facing slopes	Tree-focus	Salvaged pine-juniper soils (when available) over scoria and suitable unconsolidated shaley/sandy spoil.	11 and 12	PJO = 3-6 Scoria = 12-15 Spoil = 24-30	Mule Deer (Year-round habitat)	397
	Moderate to Steep south-facing slopes	Mixed shrub-focus and grass/ forb-focus	Suitable Spoil (SS) and scoria.	12 and 16	Scoria = 6-18 SS = 8-18	Mule Deer (Winter habitat)	1,084
	Draws	Mixed shrub-focus and grass/forb-focus	Generic topsoil with areas of suitable spoil or scoria where shrub and shrub-forb mosaics are seeded.	10, 10b, 12, 16, and 17	A = 2-6 B = 7-14 Scoria = 6-18 SS = 8-18	Mule Deer (Year-round habitat)	403
	Terraced basins						
	Benchland	Grass/forb-focus	Generic topsoil	13a, 13c, and 17	A = 2-6 B = 7-14	Sage-grouse (Spring-summer habitat) Mule Deer (Year-round habitat)	1,452
	Moderate north-facing slopes	Sagebrush shrub-focus	Topsoil, suitable spoil, and scoria	12, 13, 16, and 17	Scoria = 6-18 SS = 8-18	Sage-grouse (Year-round habitat) Mule Deer (Year-round habitat)	1,019
	Pond	Wetland	Spoil	10, 10b, and 16	SS = 8-18	Variable	3
						Total	7,156

[1]Preferred substrate is described in the Spring Creek Mine Reclamation Plan (Section 313(1)(g)(ii)).

[2] Associated with each revegetation type is a topsoil thickness range or a different substrate (Section 313(1)(g)(iii)). Where topsoil is the seeded substrate, the mean for all samples must fall within the designated ranges. The following percentages of individual samples will fall within each targeted land use type:

Pastureland: 85% of samples above the lower range.
Grazing Land: 70% of samples above the lower range.
Wildlife Habitat: 40% of samples above the lower range.

[3] Pastureland and Grazing Land are discussed in the footnotes of Table 313-3 above. The acreage of each habitat component was determined from MDEQ requirements and Federal Lease stipulations as follows: 1) Steep North-facing slopes - These areas are designed to reclaim 300 acres that are capable of supporting a pine-juniper type based on slope, aspect, and substrate. 2) Moderate to Steep South-facing slopes, Draws, Terraced Basins, Benchland, and Moderate North-facing slopes – These areas will be reclaimed to fulfill Federal Lease MTM-69782 to "restore disturbed lands to their full potential as mule deer winter range". As discussed in Addendum 313B, substantial "winter range" occurs around the SCM perimeter and is likely not a limiting factor; further, providing a variety of forages to supplement traditionally considered "winter forage" such as shrubs, with other nutritious forages can improve overall deer survival and production. Federal Lease MTM-69872 specified reclamation for mule deer on 2,505 acres. This acreage is included as part of the following partitions: 300 acres as north-facing slopes>20%; 645 acres as south-facing slopes 10 to >20%; 218 acres of draws and terraced basins; 619 acres of benchland; and 723 acres of north-facing slopes 10 to 20%.
3) Benchland – The benchland reclaimed as mule deer habitat in fulfillment of lease MTM-69782 includes additional acres will be reclaimed as benchland to fulfill Federal Leases MTM-94378 and MTM-88405 to provide habitat for mule deer and grouse. 4) Moderate North-facing slopes - These areas will be reclaimed to fulfill Federal Lease MTM-69782 which specifies that 848 acres will be reclaimed as habitat for sage-grouse. In the Pearson Creek Amendment, only 108 acres of this habitat will be disturbed. The major permit revision adds the LBM coal resulting in an additional 740 acres of disturbance. Additionally permitting the state coal lease C-1088-5 requires reclaiming 273 acres with a focus of sage grouse Wildlife Habitat. The 273 acres is included in the Benchland and Moderate north-facing slopes categories.

(h)(ii) Schedule of Revegetation

Transplanting will occur in spring. Seeding will occur at the first suitable opportunity following coversoil application for dormant fall or spring seeding, assuming seedbed conditions are favorable. An example of an unfavorable seedbed condition is a dry, powdery seedbed in fall. In this case, waiting for spring seeding may provide a better opportunity for successful revegetation.

SCM recognizes the need for a more natural mode of revegetation than simultaneous seeding a set of species, regardless of their usual role in vegetational development or realized niches. Premine vegetation developed in the fullness of time under varying climatic conditions and historic land uses in conjunction with natural site features such as substrate, topography, and hydrology. SCM is faced with achieving a facsimile of natural or semi-natural vegetation in a compressed time schedule to achieve Phase III bond release. This requires the realistic and flexible application of approved husbandry practices that do not reset the bond release clock, along with the realization that a close approximation of premine revegetation cannot always be fully re-created in a single decade, nor would that necessarily be desirable. In particular, diversity and utility objectives require a more flexible seeding and transplanting timeframe.

The role of revegetation in creating suitable postmine land uses is predicated first on matching seed mixes to habitats, primarily substrates and topography, but effective implementation also requires incorporating temporal considerations. In semiarid areas, woody plants often establish episodically, with high mortality until plants are well established. Likewise, a temporal approach to revegetation will be required. The appearance of shrub-steppe may take years or decades to develop, depending upon species, soil moisture regime, and land management. Open coniferous woodland could take several decades with the slow growth rates at SCM assuming little mortality. The goal is to initiate development of plant communities that allow the desired land uses, not deliver them fully developed.

Normal Husbandry Practices

SCM will use the normal husbandry practices in accordance with applicable Rules [e.g. ARM 17.24.718 (2)(management techniques) and 725(1) (period of responsibility-normal husbandry practices)] to manage reclaimed areas to achieve Phase III bond release. SCM's record of management and treatments for each Permit Area Reclamation (PAR) field will document the use of any normal husbandry practice, including a description of the treatment and the desired objectives, cumulative use of management practices, and initial results of individual treatments.

Augmentation of reseeding, including seedbed preparation, is considered the re-initiation of revegetation. Enhancing the existing reclamation by interseeding, providing it is completed a minimum of six years preceding a Phase III bond release application being submitted, may take several forms without resetting the bond release clock as defined in the MDEQ Normal Husbandry Practices document. Such forms may include:

- In enhancement areas where wildlife habitat is the dominant land use, the entire area may be interseeded with Seed Mixes #11a, #12a, #13c, or #16a no later than six years before the Phase III bond release application is submitted.

- Enhancing shrub mosaics on both generic coversoil and soil substitutes may be accomplished by interseeding using the appropriate seed mix (Mix #10b, #12a, #13c, or #16a). Interseeding may be implemented by broadcasting, using a no-till drill, or other innovative seeding technique.
- Enhancing upland and alluvial sites by interseeding the shrub mosaic seed mixes (#10b, #13c) via broadcasting or no-till drilling may be implemented, possibly in conjunction with some other management practice such as grazing.

Where competitive grasses establish well but additional shrubs are desired to enhance the mix of postmine land uses, SCM is permitted to chemically fallow narrow strips through the established revegetation. This will occur while the plants are actively growing, as the herbicide must be taken into growing foliage to be effective as defined in the MDEQ Normal Husbandry Practices Document.

Standing and belowground portions of dead grasses and forbs will provide a useful degree of erosion control. Standing plant litter can aid establishment of selected forbs, shrubs, or warm-season grasses. Application areas, which will comprise <20% of any field, will be clearly visible. After the plants have died, hard-to-establish shrubs (and possibly other desired growth-forms) will be seeded into the plant litter. Along these visible swaths, the following shrub mosaic seed mixes may be broadcast, or just selected elements of these mixes:

- In alluvial shrub-steppe, the mix described in Seed Mix #10b. In upland shrub-steppe or steppe, the mix described in Seed Mix #13c.

Chemical treatment will be designed to avoid impacting adjacent areas and, to the degree possible, to target only those species that impair establishment of the desired species. Herbicide usage will comply with the label guidelines, the approved permit, and all applicable local, state, and federal laws and regulations. Plant-back restrictions particular to each herbicide may apply. Herbicides used will be compatible with the species to be seeded/planted following treatment or rendered ineffective through decomposition or being adsorbed onto organic matter or soil particles.

(h)(iii) Seed Mixes and Transplants

SCM will continue to use high quality certified seed in its revegetation. SCM will use cultivars proven to be adapted to local climatic conditions. Seed unavailable as cultivars will be of Montana or Wyoming origin to the extent feasible. To promote good survival, SCM will purchase seed of MT-WY origin (or equivalent) for Wyoming big sagebrush, silver sagebrush, and fourwing saltbush unless otherwise authorized by MDEQ.

Whenever possible, SCM will use seed that has been de-awned (e.g., needle-and-thread) or defuzzed (any chaffy seed such as composite shrubs and subshrubs, asters, and winterfat) or dewinged (chenopod shrubs). Seed older than two years will be tested for germination (or tetrazolium tested) before use.

In the interest of reducing interference competition between strong- and weak-establishing species (e.g., western wheatgrass vs big sagebrush), the pounds of Pure Live Seed (PLS)/acre

seed rate of the stronger establishing species may be reduced to spatially segregate the seed of different species.

Appropriate cultivars are identified for the main seed mixes at the end of Section 17.24.313. Note that yellow-flower alfalfa, *Medicago sativa ssp falcata*, is a drought-tolerant variety of alfalfa.

Seed mixes are reevaluated routinely and modified with species from corresponding alternative lists (also attached). Prior to application on reclamation in any permitted area, all mixes will be reviewed based upon availability and suitability with substitutions allowed from the alternative list. Mix changes will be proposed to MDEQ if desired. Approval will be obtained before making substitutions other than those approved in Seed Mixes. Plate 4A indicates the land use areas as specified below.

General Planting of Trees and Shrubs

SCM's commitment to establishing trees and shrubs varies by land use. To varying degrees, shrubs will be seeded in all land uses except pastureland (Section 17.24.313 (1)(h)(iii)). Shrub densities will be greatest in wildlife habitat. Portions of this land use will be managed to become open coniferous woodland.

SCM has demonstrated through past revegetation that upland and some riparian shrubs can be satisfactorily stocked through seeding. However, SCM reserves the option of transplanting shrubs or trees to achieve particular objectives in designated areas.

The two conifer species desired in open coniferous woodland, Ponderosa pine and Rocky Mountain juniper, will also be seeded (Seed Mix #11 and Seed Mix #11a). This mix is designed to reduce competition with establishing trees and shrubs. SCM may delay seeding of herbaceous species to reduce competition for enhanced survival, especially in riparian areas. Seeding substrates suitable for transplanting upland species usually leave many areas unstocked at a microscale, so transplants can be placed to minimize competition. If seeding conifers doesn't achieve stocking objectives, SCM will transplant seedlings using special measures to promote their survival outlined in Section 17.24.313(1)(h)(iii) Open Coniferous Woodland.

Transplants will be of local origin or from areas of similar climate. The following species, and possibly others, may be transplanted singly or in appropriate combinations at selected sites throughout reclaimed areas:

Ponderosa pine	juniper	skunkbush sumac
big sagebrush	wild rose	cottonwood
chokecherry	green ash	boxelder
snowberry	currant	willow

Other species may be transplanted with Department approval. The main transplanting areas will be within units where Wildlife Habitat is the dominant land use. As shown in Table 313-4 above, SCM commits to reclaim 300 acres that are capable of supporting a pine-juniper type based on slope, aspect, and substrate. Pines and junipers will be seeded on 91

acres and skunkbush sumach on 18 acres as discussed in Section 4.0 of Addendum 313B. The success density goal for the seedings will be 912 trees per hectare for pines/ junipers and 186 skunkbush sumac per hectare for skunkbush sumac. These density goals are based on the acreage-weighted mean of pine-juniper and skunkbush sumach types derived from the Pearson Creek, Carbone and South Fork Expansion vegetation baseline studies. If the density goals are not achieved; SCM will replant those areas using transplants at rates twice the density goal. The density goals will not affect an assessment of bond release, rather, replanting would be an action that SCM would undertake solely to attempt to improve tree density for eventual use by wildlife. In order to avoid counting non established stubby cells for bond release, SCM will wait a minimum of three growing seasons after tree plantings before Phase III bond release measurements are taken. In general, the conifers will be placed on cool aspects and the sumac on warm aspects. Both will be transplanted into scoria or sandy substrates to the extent possible.

These following substrates will be used as the transplanting medium for conifers/sumac. In areas where a fine-textured substrate is present, coarse material such as scoria or sandy overburden will comprise the top two feet where conifers or sumac are desired. To the extent that it is available, the upper six inches of salvaged PJO or GHF soils will be placed atop the scoria or sandy material. If unavailable, additional fill will be added to bring the depth of coarse-textured material to a thickness of two feet. Where the base substrate is suitable, e.g., in situ scoria or sandy material, it will be ripped as necessary prior to planting/seeding.

After reconstructed drainages connect with undisturbed upstream reaches, riparian trees and shrubs will be transplanted to form shrub/tree concentration areas in and adjacent to stream channels, small depressions or other sites that present opportunities to enhance habitat diversity, especially in and near ponds or other depressions within channels. Riparian tree/shrub plantings will occupy approximately 10 acres at eight or more separate locations.

Measures will be taken to reduce depredation by wildlife, especially mule deer. Examples are fencing or treatment with deer-repellent chemicals; the latter is a temporary measure requiring reapplication. Tree protectors (plastic sleeves surrounding plants) or biodegradable mesh stockings may also be used. Mule deer in this area have shown an uncanny ability to locate and destroy widely separated unprotected seedlings of ponderosa pine, sumac, big sage and juniper. Wind damage has also had devastating effects on unprotected conifer seedlings.

Mulching, watering, grain stubble, and other aids to establishment will be employed where practicable to achieve woody seedling establishment. Judicious placement of seedlings by professional planting crews can greatly improve survival when compared to random placement. Use of natural shelters or even piling rocks can reduce insolation and desiccating winds.

Transplants of ponderosa pine, sumac, juniper, cottonwood, wild rose, chokecherry, green ash, American plum, willow, currant, and snowberry have been, and will continue to be, placed at selected locations within reclaimed areas. However, the hydrology of unconnected drainages is generally inimical to survival of riparian species, and even watered conifers planted in spoil have died.

Topography is selected with consideration for species type, slope, aspect, soil type, moisture requirements, and goals of desired wildlife habitat features. Transplanting is normally scheduled in spring because it usually results in lower mortality than fall transplanting.

Compared to seeding, transplanting plays a minor role in SCM revegetation. The main use of transplants is to establish an incipient open coniferous forest type. The two main species, which will probably be planted as 10-cubic-inch seedlings, are Ponderosa pine and Rocky Mountain juniper as mentioned above. In areas of suitable hydrology, green ash (*Fraxinus pennsylvanica)*, boxelder (*Acer negundo*), and plains cottonwood (*Populus deltoides*) may be transplanted.

In addition, SCM may transplant as seedlings a variety of shrubs that may include, but not be limited to, *Prunus americana, Prunus virginiana, Rhus trilobata, Ribes aureum, Rosa spp., Shepherdia argentea,* and *Symphoricarpos occidentalis*. Most of these shrubs require enhanced soil moisture; special habitat requirements must be present before transplanting. The occurrence of favorable microsites cannot be predicted in advance of final grading and coversoil laydown. Drainages must be connected and open to upper reaches.

Fertilizer may be used as a carrier for trashy seed; the amount of fertilizer used will be determined based on the ability of a particular seed mix to feed in a particular seeding implement. The rate of fertilizer application is so low as to be all but irrelevant in terms of plant growth and does not fall outside normal husbandry practices.

Eighteen seed mixes are proposed for different land uses, substrates, and conditions. These mixes are identified in Table 313-5. Seed mixes are described at the end of Section 17.24.313.

Table 313-5. List of Seed Mix Names

SEED MIX#	SEED MIX NAME
10	ALLUVIAL SHRUB-STEPPE
10a	ALLUVIAL SHRUB STEPPE – ALLOWED ALTERNATIVE SPECIES
10b	ALLUVIAL SHRUB MOSAICS
11	PINE-JUNIPER WOODLAND
11a	P-J WOODLAND INTERSEEDING
12	SCORIA SEED MIX
12a	SCORIA INTERSEEDING MIX
13a	UPLAND SHRUB-STEPPE, LOWER SLOPES
13b	ALLOWED ALTERNATIVE SPECIES FOR ABOVE
13c	SHRUB-STEPPE MOSAICS
13d	UPLAND SHRUB-STEPPE, UPPER SLOPES
13e	ALLOWED ALTERNATIVE SPECIES FOR ABOVE
13f	UPLAND SHRUB-STEPPE, REPAIR AREA MIX
14	TEMPORARY SEED MIX
15	STEPPE SEED MIX
15a	STEPPE INTERSEEDING MIX
16	SUITABLE SPOIL SEED MIX
16a	SUITABLE SPOIL INTERSEEDING MIX
16b	SUITABLE SPOIL ALLOWED ALTERNATIVE SPECIES FOR ABOVE
17	SAGEBRUSH-FORB MOSAIC SEED MIX

(h)(iv) Use of Introduced Species

The use of introduced species is proposed in two circumstances:

1. Inoculated alfalfa is being included in most basic seed mixes at a rate of about one-half pound PLS/acre less. Where alfalfa establishes, it will benefit the soil through nitrogen fixation, boosting productivity while providing forage for all herbivorous mammals and sage and sharptail grouse.
2. Cereal grains may be used to provide temporary cover and erosion control or as a preparatory crop.

(h)(v) Planting and Seeding Methods

Revegetation will conform to 82-4-233, MCA. SCM will establish vegetation in accordance with the approved permit and reclamation plan on all disturbed/regraded areas except water, road surfaces, and approved constructed features. In general, SCM will use Table 313-4 above as a guide for choosing which seed mixes need to be applied to achieve the post mining land use.

Providing more detailed information, such as specifying types named for dominant plant species far in advance of reclamation, is impossible for these reasons:

1. SCM can specify what it will seed but not which species will thrive. Each seed mix contains a host of species; which ones will become dominant either initially or from

interseeding/reseeding or in the course of vegetational development as influenced by weather and management activities cannot be predicted. In the past, predicting detailed revegetation types by acreage proved to be tenuous.

2. Depending on what type of vegetation develops from early seedings, later seeding in nearby areas may be chosen to bring the larger area into compliance with the designated land use. Thus the realized vegetation type for each field within the disturbance limits cannot be known in advance.

3. SCM usually does not know what the precise configuration of a field will be, what substrate will be used, etc. until shortly before it is constructed (e.g., one year or less). That is when a seed mix appropriate for the designated land use and site is chosen.

4. When operational opportunities to create diverse micro topography arise, SCM will capitalize on those opportunities as appropriate.

For these reasons, SCM's revegetation plan has proactive and adaptive elements.

Mixed seedings will be conducted in a manner and at a time that will avoid deleterious competition among species. Different seeding techniques will be used to accommodate seeds of different sizes. Section 17.24.313(1)(h)(ii) above discusses special seed treatments that will facilitate mechanical seeding.

SCM will use a variety of seeding techniques. Three variables determine seeding technique:

1. Condition of the seedbed.
2. Available farming and seeding equipment.
3. Seed characteristics.

Available seeding equipment changes through time, but most permanent seeding probably will be done with some of the following equipment:

- A rangeland "drill" or other device that delivers seed at or near the surface. Packer wheels and/or drag chains may be used in conjunction with this implement. A rangeland drill can apply any SCM seed mixes that will feed through it.
- Cereal grain cover crops and the heavy-seeded component of most seed mixes may be seeded with a grain-type drill that also can be used without tillage to repair fields or portions of fields. To combine drill and broadcast seeding, seed must be ordered in two sets of bags.
- Shrub mosaic seed mixes (Seed Mixes 10b and 13c), interseeding seed mixes (Seed mixes 12a and 16a), and seed mixes designed for scoria substrates (Seed Mixes 11, 11a, 12, and 12a) may be broadcast as circumstances dictate. Where a two-phase seeding is practiced (heavy and light seed applied separately), the light component can be broadcast on the surface separately from the heavy seed. A light harrowing (e.g., a chain harrow) following broadcast seeding is usually beneficial on soil substrates, while a heavier rake harrow is more beneficial on scoria or rocky substrates.

Seedbed condition is a prime determinant of seeding success or failure. Standard techniques may be modified to accommodate specific conditions. Skilled operators are granted the

flexibility to improvise seeding and seedbed preparation methods and modify revegetation practices. In some cases, this may require regulatory approval.

To achieve wildlife utility based on shrub densities without sacrificing erosion control, productivity, and livestock utility over large areas, SCM proposes a variety of shrub and forb establishment strategies. The five main strategies are:

- Seeding shrubs, especially the strong-establishing ones, as part of general seed mixes.
- Interseeding using shrub or forb mosaic seed mixes in designated mosaics.
- Creating shrub mosaics on either topsoil or special substrates using seed mixes that don't compete strongly with shrubs.
- After topsoiled sites are stabilized through revegetation, enhance the revegetated area by chemically fallowing narrow strips in topsoiled areas, followed by seeding with the more difficult-to-establish shrub, forb, and warm-season species.
- Seeding the light seed separately from the heavy seed by seeding them at different periods.

Direct seeding of pines and junipers has not been effective so far, but limited success may be related to weather patterns following seeding. In the event that initial direct seeding of pine/juniper is unsuccessful or if seed is unavailable, SCM will rely on seedling transplants to achieve required densities. Procedures for seedling planting described in 17.24.313(h)(iii) will be incorporated as appropriate to promote development of a pine-juniper woodland physiognomic type.

(h)(vi) Approximate Annual Seeding and Planting Dates

Transplanting will occur in the spring whenever possible.

Seeding and planting of disturbed areas will be conducted during the first appropriate period of favorable planting conditions after final seedbed preparation. A dormant fall or winter seeding is preferred, but spring seeding may be advantageous when the seedbed is too fluffy in the fall. The appropriate period for favorable seeding will be determined based on seedbed conditions, operational constraints, and other considerations such as wildlife depredation.

(h)(vii) Use of Cover Crop and Mechanical Erosion Control Measures

If seeding conditions appear unfavorable for permanent seeding but temporary erosion control is desired, a cereal grain may be seeded as a preparatory crop. If a preparatory crop is used, appropriate permanent mixes may be seeded later directly into the standing litter or following additional seedbed preparation. While it is unlikely to be used often, a cereal grain may be included in some seed mixtures as a nurse crop.

Mulch will be used as necessary to ensure soils are stabilized in accordance with ARM 17.24.714.

(h)(viii) Soil Tillage, Amendments, or Other Management Techniques

Due to differences in coversoil characteristics as modified by moisture content and laydown and grading practices, the final graded surface will require site-specific seedbed preparation before planting. Excessively uneven, fluffy, or clumpy seedbeds may require additional smoothing and disking or harrowing followed by light compaction before seeding. Less common are compacted surfaces, which must be ripped and disced or harrowed before seeding. SCM is continually learning through experience and is tailoring seedbed preparation to the specific conditions in each field. Standard agronomic equipment will be used to prepare a proper seedbed.

SCM may, at its discretion, use an arbuscular mycorrhizal inoculum to promote sagebrush survival on certain substrates.

Fertilization has proven unnecessary when using topsoil. The upper lift of these soils has a nutrient reservoir (organic matter) and soil food web that can sustain revegetation.

Two reclamation substrates, suitable spoil and scoria, may require initial fertilization because they lack organic matter and are biologically depauperate. Essential macronutrients, particularly nitrogen, are deficient. The initial stock of mineralized nutrients will be immobilized swiftly in vascular plants. Appropriate fertilization will increase primary productivity and thereby promote soil development. Inorganic fertilizers may be used at SCM's discretion, possibly including slow-release fertilizers.

Vegetational manipulation may include mowing, livestock grazing, approved herbicides, and/or burning.

(h)(ix) Vegetation Monitoring During Liability Period

SCM will utilize the currently approved MDEQ Annual Report Standard form to conduct periodic monitoring of reclaimed areas. Starting in 2011, SCM will monitor each Pit Area Reclamation (PAR) unit starting the next calendar year after seeding, then annually for a minimum of two years or until Phase II Bond release is achieved. However, PAR units which have been sampled from 2007-2010 will be monitored every other year starting in 2013 independent of their Phase II Bond release status. After receiving Phase II bond release, SCM will continue to monitor each PAR unit every other year until Phase III is achieved. Vegetation of PAR units granted Phase III bond release will no longer be monitored.

- Starting in 2011, SCM may sample each PAR unit as needed for Phase III Bond release. SCM may use the historically used sampling protocol described below or other MDEQ approved methods for Phase III Bond release sampling.

- PAR units will be assigned one to three permanent 50-meter transects based on field

size, assuming uniform seeding throughout the field:

FIELD SIZE (ACRES)	NUMBER OF TRANSECTS
<10.0	1
10.1-30.0	2
>30.0	3

- SCM may sample more than the minimum number of transects at its discretion. If the field has more than one seeding type, each significantly different seeding type will be sampled with at least one transect, but not each unit of each seeding type. For example, alluvial seedings or shrub mosaics large enough to sample with a 50-meter transect may be assigned transects in addition to transects representing the basic upland seed mix in a PAR field.

- Transect origins are indicated with green fenceposts; red fenceposts indicate termini. One-half-meter-square (0.5 m X 1.0 m) frames are sampled on the left side of each transect at these meter locations: 7, 14, 21, 28, 35, 42, and 48. Canopy coverage is estimated as accurately as possible within each frame.

- In addition, peak standing crop (PSC) is determined by clipping random frames on the right side of transects. Harvested material is sorted by growth-forms unless there is a need for data by species, e.g., to determine range condition. Usually the same one-half-meter-square frame locations are sampled in all the PARs being sampled for PSC that year. Harvested materials typically are air-dried in a warm, well-ventilated shelter.

- Woody plant density is measured along a 50 m^2 belt transect formed by walking down the tape (transect) with a one-meter-long dowel centered on the tape and counting shrubs rooted within the belt transect. The following shrub species are historically recognized at the SCM in baseline inventories and annual monitoring: *Amelanchier alnifolia, Artemisia cana, Artemisia tridentata, Atriplex canescens, Atriplex confertifolia, Ceratoides lanata (Krascheninnikovia l.),* all *Chrysothamnus spp (Ericameria spp.),* all *Prunus spp., Rhus trilobata,* all *Ribes spp.,* all *Rosa spp.,* all *Salix spp., Sarcobatus vermiculatus, Sheperdia argentea,* all *Symphoricarpos spp.,* and *Tetradymia canescens.*

- Canopy coverage and woody plant density are measured as described above.

- In selected shrub mosaic areas, 15-meter-long transects are located using the same fencepost color scheme described above. This line forms the left side of a 45 m^2 (15 m X 3 m) elongate plot in which all shrubs are counted. Shrubs are tallied by species and by 25 cm height classes.

- Where seedlings are transplanted, survival/mortality will be monitored and surviving density reported.

(h)(x) Measuring Revegetation Success

Revegetion requirements from Section 17.24.711

(1)(a)(1)Revegetation will be:

(a) diverse, effective and permanent;

(b) composed of native species or, where desirable, approved, and complementary to the postmining land use, introduced species;

(c) equal or greater in cover to the natural vegetation of the area;

(d) capable of controlling soil erosion to the extent appropriate for the postmining land use.

(2) Reestablished plant species will:

(a) be compatible with approved postmining land uses;

(b) have the same range of growth characteristics as baseline vegetation;

(c) be capable of self-regeneration and vegetational development;

(d) be compatible with other plant and animal species in the area;

(e) meet requirements of applicable seed, poisonous and noxious plant, and introduced species laws or regulations.

(3) Revegetation will complement the postmining land use, specifically:

(a) cropland – does not apply;

(b) utility for livestock grazing will be comparable to premining conditions, or enhanced;

(c) trees and shrubs will be planted to achieve rates appropriate for wildlife, noncommercial forestry, and dispersed recreation (see Section 17.24.762).

(b) This section does not apply as no land was seeded prior to 1984.

(2) This section does not apply as no areas are designated as prime farmland

(3) The sections below address cover, planting, and stocking specifications

(a) The department of fish, wildlife, and parks will be consulted on land uses involving fish and wildlife habitat as required by rule.

(b) This section does not apply as no areas involve forestry.

Comparisons determining revegetation success will be made for each bond-release unit (BRU), i.e., sets of fields designated by SCM. The fields in a BRU can represent multiple land uses which are statistically evaluated separately.

Livestock Utility and Wildlife Habitat Function

Livestock carrying capacity and utility will be evaluated by:

1) Comparing PSC of perennial grasses and biennial-perennial forbs to the premine carrying capacity, which as determined from baseline studies was approximately 40 acres per animal unit per year in the South Fork area, 38 acres/AUY for the Carbone area with 12% pastureland, and 59 acres/AUY for the Pearson Creek area.

Wildlife habitat use will be demonstrated by documented wildlife observations during the responsibility period.

Canopy Coverage, Peak Standing Crop, and Woody Plant Density

SCM proposes the technical performance standards below but reserves the option of evaluating revegetation by direct reference-area comparisons for Phase III bond release.

The framework for Phase III bond-release evaluations based upon vegetational parameters follows:

1) Each bond-release package consists of areas that fall into one of the land-use types listed in Table 313-3. Standards will be applied to postmine land use types within a BRU, not by applying the standards to each individual field.
2) Pastureland perennial plant cover and PSC performance standards (Table 313-6); the Wildlife Habitat perennial plant cover and woody plant density performance standard (Table 313-6); Grazing Land perennial plant cover, PSC, and woody plant density (Table 313-6).
3) A weighted mean for each parameter will be computed based on relative acreage of each transect. The procedure for computing a confidence interval on those means is described later in this section. This statistic (upper confidence interval) is compared to 90% of the standard to determine success (Section 17.24.726(2)).

Average plant cover and PSC forming the basis for the standards in Table 313-6 derive from 56 sets of samples of historic types sampled for baseline inventories or reference areas representing those types. The number of times a type was sampled in each baseline survey was determined by a sample-adequacy calculation or graph or both. Reference areas are typically sampled using three transects (21 cover frames and nine clip plots). These data are summarized in the appendices of Addendum 313B. SCM may modify cover and PSC technical standards with MDEQ approval based on additional baseline or reference area data collected in the future.

For Phase III bond release, revegetation must equal or exceed 90% of the standards in at least two years during the responsibility period beginning in the seventh year after any revegetation activity that does not qualify as a normal husbandry practice using methods next described. When bond release is proposed for a BRU, the usual monitoring data (canopy coverage, PSC, and woody plant densities as appropriate to land use) will be compiled or collected using the same transects used for PAR annual monitoring. The number of transects in a field has been determined by field size and number of special seedings within a field. In some cases, entire fields were seeded with a single mix. In others, several seedings were applied in different areas. The number of transects used for annual monitoring is defined as meeting the sample adequacy

to accurately represent the post mining vegetation community in a PAR. However, SCM must demonstrate how sample adequacy is achieved as part of the Phase III bond release application. requirement, subject to the further condition that each land use type must be represented by at least two transects to compute a variance.

1. Each BRU can have more than one land use type. The sampling transects data for each land use type will be separated. Pertinent data are compiled/collected for each field or each separate seeding within a field if it appears to differ in important characteristics such as woody plant density, perennial cover, or perennial PSC as appropriate to land use. At the discretion of SCM, separate seedings may be combined into the general land use for a field or treated as a separate land use (e.g., seedings with a specified woody plant density may be considered to be wildlife habitat and would be statistically analyzed separately).

2. The weighted mean and pooled variance for each pertinent parameter within a land use type is computed.

3. The square root of the pooled variance is the standard deviation. The appropriate t value from Table A-1 of the MDEQ Vegetation Sampling Guidelines, is multiplied by the standard deviation to give the weighted confidence interval (C.I.). This mean is added to the one-tailed (upper) confidence interval using 0.1 Type 1 error to determine the upper confidence interval. In the event that a single transect represents a land use type in a BRU, SCM agrees to sample the land use type with at least two transects to compute a variance.

4. The standard deviation, mean, number of samples, and any other number are used to demonstrate sample adequacy.

5. This result of Step 3 is compared to 90% of the standard for each pertinent parameter in (Tables 313-6). If it equals or exceeds 90% of the standard, the fields collectively pass for that parameter.

Mean perennial canopy coverage, PSC, and woody plant density from the bond-release package will be compared to 90% of the cover and PSC standards in Table 313-6 and 90% of the shrub standard for Wildlife Habitat using a one-tailed 90% confidence interval calculated from application-area sample data (ARM 17.24.726(2)) applying the following procedure adapted from Gilbert (1987).

Table 313-6. Technical Vegetation Standards

Postmine Land Use	Woody Plant Density per acre (per hectare)	Canopy Cover percent	Annual Production lbs/acre (kg/ha)
Grazing Land	450 (1112)	50	690 (*775)*
Pastureland	N/A[1]	62	948 (*1063)*
Wildlife Habitat	2322 (5738)	46[2]	N/A

[1]Grazing Land and Pastureland areas will contain 5 percent WHEFs as discussed above.
[2]Shrub density is the primary goal of wildlife land use reclamation. Young shrubs generally provide less cover than mature shrubs. Additionally, herbaceous vegetation competes with shrubs for moisture and can reduce shrub establishment. The primary goal for the wildlife land use cover standard is soil stability and erosion control. SCM will conduct a study of baseline data, reclamation and reference area data, and literature to determine what the optimal level of herbaceous cover is in a young shrub stand, and will adjust the cover standard for wildlife habitat accordingly though the minor revision process.

The procedure for calculating the mean and variance or standard deviation (square root of variance) for stratified random samples is described by Gilbert (1987) in Chapter 5, Stratified Random Sampling. Gilbert's (1987) method uses prior knowledge (e.g., different seedings) to divide the target population (e.g., the transects in a bond-release package) into land use types (subgroups) that are internally homogeneous. "If the stratification has been effective in creating relatively homogeneous strata, then the estimated average and inventory for the entire population of N units should be more accurate than would be obtained if a simple random sample had been collected from the N units without first stratifying the population" (p. 46).

(h)(xi) Quality, Fertility and Thickness of Redistributed Soil and Spoils

See Sections 17.24.313(1)(g)(iii), 17.24.501(2), and 17.24.702(4).

(h)(xii) Types of Major Equipment Used in the Above Operations

See Section 17.24.308(1)(a)
(i) Methods Used Manage Prospecting Holes and Other Holes

See Section 17.24.308 for a discussion of methods to plug, case or manage prospecting holes, wells and other drill hole openings.

(j) Facilities Reclamation Plan

Beginning in 2012, SCM will implement an ongoing program for confirming the presence or absence of contamination around mine facilities. The purpose of the program is to ensure potential contamination is identified and appropriately treated and addressed prior to mine closure, and so final bond release is not unnecessarily delayed.

Because there are no known areas of contamination at SCM, the ongoing monitoring program will focus on areas with the highest potential for contamination. The most likely

areas to have potential for contamination include fuel handling facilities and shops. The most likely contaminants include hydrocarbons with lesser potential for metals and solvents.

The following paragraphs provide conceptual-level details of the ongoing monitoring plan. Prior to implementing the monitoring plan, SCM commits to submitting a detailed work plan to MDEQ for approval. The work plan will contain detailed location maps of monitoring locations, sampling methods and frequencies, and laboratory analytical methods and reporting limits.

The ongoing monitoring plan will focus on characterizing the presence or absence of contaminants in the unconsolidated soils in the facilities areas. Characterization and monitoring of groundwater will be performed if soils contamination is encountered. Table 313-7 below summarizes the ongoing monitoring program to be performed every 10 years (or at an appropriate frequency determined in consultation with MDEQ):

Table 313-7. Conceptual Ongoing Contamination Characterization Program

Media	Monitoring Location	No. of Borings	Sample Intervals (ft bgs) [(a)]	No. Samples	Analytes
Soil	Main Fuel Island	4	0-2, 8-10	2 per boring	GRO, DRO
	Landfarm and Wash Bay Sump Drying Cells	6	0-2, 8-10	2 per boring	DRO, Hydraulic Oil
	Bulk Fuel Storage Facilities	2 per each storage facility	0-2, 8-10	2 per boring	GRO (Tank 5 only), DRO, Hydraulic Oil
	Waste Storage Facility and New Wash Bay	4	0-2, 8-10	2 per boring	DRO, Hydraulic Oil, Metals, Solvents
	Plant Shop	4	0-2, 8-10	2 per boring	DRO, Hydraulic Oil
	Complex Maintenance Shop	10	0-2, 8-10	2 per boring	GRO, DRO, Hydraulic Oil, Metals, Solvents
	Decommissioned, Abandoned or Otherwise	4	0-2, 8-10	2 per boring	GRO, DRO, Hydraulic Oil, Metals,

	Historic Fuel and Waste Storage Facilities				Solvents
Groundwater	The need to conduct groundwater characterization around the facilities will be determined upon completion of the soils monitoring program in consultation with MDEQ.				

Notes:
ft bgs – feet below ground surface
GRO – gasoline range organics
DRO – diesel range organics
(a) – In many cases, it is expected that bedrock will be encountered before the 8-10 ft bgs interval can be sampled; in these instances, the lowermost unconsolidated material will be sampled.

Following completion of each monitoring effort, a summary report will be prepared for submittal to MDEQ. The report will summarize all analytical data and contain recommendations for additional work based on findings, as necessary. If contamination is encountered, additional consultation with MDEQ will be performed which may include additional sampling work to define nature and extent of any contamination and development of possible treatment and/or remedial alternatives. Subsequent monitoring efforts will focus efforts on area where known releases have occurred or where contamination was discovered previously (though a work plan describing the effort will be submitted to MDEQ for approval).

At the conclusion of mining activities, all facilities, structures, buildings and roads will be removed and the resulting surface will be regraded to the approved postmining contours shown on Plate 4. SCM commits to developing and implementing a facility reclamation plan (at the time of closure), to be approved by MDEQ, to demonstrate facility areas meet applicable requirements. The facility reclamation plan will include work to demonstrate site media (e.g., soil and water) meet applicable regulatory criteria. Following regrading operations, the areas will be resoiled and planted with an approved seed mix at the first available suitable opportunity. See also Section 17.24.308(1)(b)(v) and the Reclamation Bond calculation in Appendix M.

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LIST OF SEED MIXES

ALLUVIAL	
Seed Mix #10	Alluvial Shrub-Steppe Seed Mix
Seed Mix #10a	Alluvial Shrub Steppe – Allowed Alternative Species
Seed Mix #10b	Alluvial Shrub-Steppe Shrub Mosaic and Chemical Fallow Interseeding Seed Mix, Alluvial Soils
WOODLANDS	
Seed Mix #11	Pine-Juniper Woodland Seed Mix
Seed Mix #11a	Pine-Juniper Woodlands Interseeding Mix
SCORIA	
Seed Mix #12	Scoria Seed Mix
Seed Mix #12a	Scoria Interseeding Mix
UPLAND SHRUB STEPPE	
Seed Mix #13a	Upland Shrub-Steppe in Lower Slope Positions
Seed Mix #13b	Allowed Alternative Species for Above
Seed Mix #13c	Upland Shrub-Steppe Shrub Mosaics and Chemical Fallow
Seed Mix #13d	Upland Shrub-Steppe in Mid to Upper Slope Positions
Seed Mix #13e	Allowed Alternative Species for Above
Seed Mix #13f	Upland Shrub Steppe Repair Area Mix
STOCKPILES, TEMPORARY REVEGETATION	
Seed Mix #14	Temporary Seed Mix
GRASSLANDS (STEPPE)	
Seed Mix #15	Steppe Seed Mix
Seed Mix #15a	Steppe Interseeding Seed Mix
SUITABLE SPOIL	
Seed Mix #16	Suitable Spoil Seed Mix
Seed Mix #16a	Suitable Spoil Interseeding
Seed Mix #16b	Allowed Alternative Species
SPECIAL USE	
Seed Mix #17	Sagebrush-Forb Seed Mix

Note: Any of the seed mixes listed above may be applied to topsoil, scoria, suitable spoil, or a mixture thereof as necessary for successful revegetation.

LIST COMMON AND SCIENTIFIC NAMES FOR REFERENCE

Alfalfa and Yellow-Flowered Alfalfa	*Medicago sativa*
Alkali sacaton	*Sporobolus airoides*
American Vetch	*Vicia americana*
Basin wildrye	*Leymus cinereus*
Big bluegrass	*Poa juncifolia var. ampla or Poa secunda var. ampla*
Big Sagebrush	*Artemisia tridentata ssp. wyomingensis*
Blacksamson Echinacea	*Echinacea angustifolia*
Blanketflower	*Gaillardia aristata*
Blue Flax	*Linum perenne*
Bluebunch wheatgrass	*Pseudoroegneria spicata*
Canada wildrye	*Elymus canadensis*
Common or annual sunflower	*Helianthus annuus*
Cudweed sagewort	*Artemisia ludoviciana*
Fourwing saltbush	*Atriplex canescens*
Fringed sagewort	*Artemisia frigida*
Gardner saltbush	*Atriplex gardneri*
Greasewood or black greasewood	*Sarcobatus vermiculatus*
Green needlegrass	*Nassella viridula*
Indian ricegrass	*Achnatherum hymenoides*
Little bluestem	*Schizachyrium scoparium*
Needle-and-thread	*Hesperostipa comata*
Ponderosa pine	*Pinus ponderosa*
Prairie aster	*Symphyotrichum falcatum*
Prairie coneflower	*Ratibida columnifera*
Prairie Junegrass	*Koeleria macrantha*
Prairia milkvetch	*Astragalus adsurgens*
Prairie sandreed	*Calamovilfa longifolia*
Purple prairie clover	*Dalea purpurea*
Rocky mountain juniper	*Juniperus scopulorum*
Rubber rabbitbrush	*Ericameria nauseosa*
Sand dropseed	*Sporobolus cryptandrus*
Sandberg bluegrass	*Poa secunda*
Scarlet globemallow	*Sphaeralcea coccinea*
Shadscale saltbush	*Atriplex confertifolia*
Sideoats grama	*Bouteloua curtipendula*
Silver sagebrush	*Artemisia cana*
Skunkbush sumac	*Rhus trilobata*
Slender wheatgrass	*Elymus trachycaulus*
Snake River wheatgrass	*Elymus wawawaiensis*
Squirreltail	*Elymus elymoides*
Switchgrass	*Panicum virgatum*

Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*
Thickspike wheatgrass	*Elymus lanceolatus*
Trailhead Basin wildrye	*Leymus cinereus*
Waxleaf Penstemon	*Penstemon nitidus*
Western aster	*Symphyotrichum ascendens*
Western wheatgrass	*Pascopyrum smithii*
Western yarrow	*Achillea millefolium*
White prairie clover	*Dalea candida*
Winterfat	*Krascheninnikovia lanata*
Yucca (Spanish Bayonet)	*Yucca glauca*

Seed Mix #10

Alluvial Shrub-Steppe Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Western Wheatgrass *Recovery.)*	1.5-2	4-5	*Rosana (If unavail.,*
Green Needlegrass	0.8-1.2	3-5	*Lodorm*
Basin Wildrye	0.8-1.2	2-4	*Trailhead*
Canada Wildrye	0.6-0.8	2	*Mandan* or vns
Slender Wheatgrass	0.6-0.8	2-3	*Pryor, Revenue, First Strike*
*Big Bluegrass	0.4-0.6	8-12	*Sherman*
Grasses, Warm-Season			
*Alkali Sacaton	0.8-1.2	32-48	
Legumes			
American Vetch	0.4-0.6	<1	
Yellow-flowered Alfalfa	0.4-0.6	2-3	*Pre-inoculated var. falcata*
Forbs			
*Western Yarrow	0.2-0.4	17-21	*N. Am. origin*
Prairie Coneflower	0.4-0.6	9-11	
Subshrubs and Shrubs (Northern Plains origin desired for all shrubs.)			
*Cudweed Sagewort	0.2-0.3	20-31	
*Silver Sagebrush	1.8-2.2	35-43	*Plains not mountains origin*
*Winterfat	0.4-0.6	<1	
Greasewood[2]	1.3-1.7	7-10	*Must be de-winged*
Fourwing saltbush[2]	0.8-1.2	1-2	*Must be de-winged*

Total application rate varies with technique and equipment. This mix can be applied at by a combination of broadcast and drill seeding. For some applications, THE HEAVY AND LIGHT SEED MUST BE ORDERED IN SEPARATE BAGS. S**pecies denoted by an asterisk* are suitable for broadcast seeding.** Alfalfa can also be broadcast seeded.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #10a

Alluvial Shrub Steppe Seed Mix
Allowed Alternative Species*

Grasses, Cool-Season	*Preferred Cultivar*[1]
Thickspike Wheatgrass	*Critana*
Legumes	
Alfalfa	*A rhizomatous variety suitable for semiarid climate,* *Pre-inoculated.*
Forbs	
Echinacea angustifolia	
Subshrubs	
Fringed Sagewort	
Shrubs	
Wyoming Big Sagebrush of suitable origin may be substituted for one shrub in Mix 10.	

*These species will be seeded at a rate to correspond to the effective seeding rate of the species they replace in the basic mix.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #10b

Alluvial Shrub-Steppe Isolated Shrub Mosaic and Chemical Fallow Interseeding Seed Mix, Alluvial Soils

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Switchgrass	0.5-1.0	4-9	*Summer, Sunburst, Dakotah or Forestburg*
Silver Sagebrush	2.5-3	50-60	*Northern Plains origin*
WY Big Sagebrush	0.8-1.2	46-69	*Northern Plains origin*
Cudweed Sagewort	0.2-0.4	45-55	
Winterfat	0.4-0.6	<1	*Northern Plains origin*
Sideoats Grama	0.8-1.2	4-5	*Pierre, Killdeer, Butte*
Sand Dropseed	0.4-0.6	55-65	
Alkali Sacaton	0.8-1.2	32-48	

This generally light-seeded mix is intended to be broadcast on calm to slightly breezy days using fertilizer (ammonium nitrate), cracked corn, or rice hulls as a carrier. Overfilling the hopper may result in "bridging." Some compaction or light harrowing is usually desirable following broadcast seeding, depending upon seedbed condition.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #11
Pine-Juniper Woodland Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Bluebunch Whtgrss, 2 vars. *Anatone*	1.5-2.0	5-7	*Secar,Discovery, P-7, or*
Indian Ricegrass	1.5-2.0	5-6	*Rimrock or Nezpar*
Western Wheatgrass	0.8-1.2	2-3	*Rosana (Recovery if unavail.)*
Prairie Junegrass	1.0-1.5	53-80	*Not Barkoel*
Grasses, Warm-Season			
Prarie Sandreed	0.5-0.8	3-5	*Goshen*
Little Bluestem *ecotype*	0.5-0.8	3-5	*Itasca, Spirit ecovar, Badlands*
Legumes			
Yellow-Flower Alfalfa	0.4-0.6	2-3	*Pre-inoculated var. falcata*
White Prairie Clover	0.4-0.6	3-5	*Antelope or other*
Forbs			
Prairie Coneflower	0.4-0.6	10-13	
Western Aster as available	0.3-0.5	18-30	
Tanseyleaf Tansyaster	0.3-0.5	3-5	
Yucca	0.8-1.2	<1	
Shrubs and Subshrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Rubber Rabbitbrush	0.4-0.6	4-6	*Must be defuzzed*
Wyoming Big Sagebrush	1.5-2.0	86-115	
Skunkbush Sumac	0.8-1.2	<1	
Trees (Northern Plains origin desired for all trees. Source Lawyer or Timberline.)			
Rocky Mountain Juniper	1.8-2.2	1-2	
Ponderosa Pine	3.5-4	1	

For scoria or other coarse-rocky substrate. While predominantly heavy-seeded, this mix is intended to be **broadcast seeded** on calm to slightly breezy days followed by a heavy, aggressive harrow or, if too rocky, a chain harrow. **Alternative Species For Mix #11:** any two species in Seed Mix #11 can be omitted. E*chinacea angustifolia* or an adapted native *Penstemon* such as Waxleaf or Fuzzytongue Penstemon can be added up to 0.5 pounds PLS/acre.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #11a
Pine-Juniper Woodlands
Interseeding Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Bluebunch Wheatgrass	0.8-1.2	2-3	*Goldar*
Prairie Junegrass	1.0-1.5	53-80	*Not Barkoel*
Grasses, Warm-Season			
Sideoats Grama	0.8-1.2	3-5	*Pierre, Butte, Kildeer*
Shrubs and Subshrubs (Northern Plains origin desired for all shrubs.)			
Rubber Rabbitbrush	0.3-.5	4-5	*Must be defuzzed*
Wyoming Big Sagebrush	1.0-2.0	57-115	
Trees (Northern Plains origin desired for all trees. Source Lawyer or Timberline.)			
Rocky Mountain Juniper	1.8-2.2	0-2	
Ponderosa Pine	3.5-4	0-2	

This mix is intended to be **broadcast seeded** into a coarse substrate with some burial (e.g., a rake harrow) on calm to slightly breezy days. Overfilling the hopper may result in the tree seed coming out quickly while light, fluffy seed "bridges." Harrowing followed by light compaction is usually desirable following broadcast seeding, depending upon substrate and seedbed condition.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #12

Scoria Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Snake River or BB Whtgrs *Anatone*	2.0-2.5	6-8	*Secar, P-7 germ, Discovery,*
Western Wheatgrass *unavail.)*	0.8-1.2	2-3	*Rosana (Recovery if Rosana*
Indian Ricegrass	1.5-2.0	5-7	*Nezpar or Rimrock*
Squirreltail (bottlebrsh s-tail)	0.8-1.2	3-5	
Sandberg Bluegrass *Home*	0.4-0.6	8-13	*High Plains, MT-1, Mountain*
Grasses, Warm-Season			
Little Bluestem *ecotype*	1.0-1.5	6-9	*Itasca, Spirit ecovar, Badlands*
Sideoats Grama	0.4-0.6	2-3	*Pierre, Killdeer, Butte*
Legumes			
White Prarie Clover	0.8-1.2	6-10	*Antelope or other*
Forbs			
Prairie Coneflower	0.4-0.6	10-13	
Western Aster if available	0.3-0.5	19-30	
Tanseyleaf Tansyaster	0.3-0.5	3-5	
Yucca	0.8-1.2	<1	
Shrubs and Subshrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Rubber Rabbitbrush	0.4-0.6	4-6	*Must be defuzzed*
Wyoming Big Sagebrush	1.5-2.0	86-115	
Skunkbush Sumac	0.8-1.2	<1	

This mix is intended for coarse scoria with lots of rock fragments. It should be broadcast seeded at approximately 15 pounds PLS/acre on calm to slightly breezy days using fertilizer (ammonium nitrate), cracked corn, or rice hulls as a carrier. Overfilling the hopper may result in light/fluffy seed "bridging." A heavy rake harrow may be beneficial if the rocks aren't too large.

Seed Mix #12 contains 14 adapted species; up to two species may be deleted without substitution. Aster availability is erratic. Any *Oxytropis sp., Astragalus adsurgens, Echinacea angustifolia,* or an adapted penstemon forb may be substituted if available.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to

uncertain availability.

Seed Mix #12a

Scoria Interseed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Prairie Junegrass	0.5-1.0	26-53	*Not Barkoel*
Canada Wildrye	0.8-1.2	2	
Grasses, Warm-Season			
Little Bluestem	1-1.5	6-9	*Itasca, Spirit ecovar, Badlands ecotype*
Sideoats Grama	0.8-1.2	3-5	*Pierre, Butte, or Killdeer*
Forbs			
Prairie Coneflower	0.3-0.5	3-5	
Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Wyoming Big Sagebrush	1.8-2.2	105-125	
Rubber Rabbitbrush	0.6-0.8	5-7	*Must be defuzzed*
Silver sagebrush	0.6-0.8	12-16	*Plains not mountains origin*

This mix is intended for **coarse scoria with lots of rock fragments.** It should be **broadcast seeded in calm conditions**. If a carrier is needed, use fertilizer (ammonium nitrate), cracked corn, or rice hulls. Overfilling the hopper may result in light/fluffy seed "bridging." A fairly aggressive harrow may be required behind the seeder, depending upon plant establishment from the initial seeding and rock fragment size.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #13a

Upland Shrub-Steppe
Lower Slope Positions, Lesser Slope Gradients, Soil Deposition Areas

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Slender Wheatgrass	0.6-0.8	2-3	*Pryor, Revenue, First Strike*
Western Wheatgrass	1.7-2.3	4-6	*Rosana (Recovery if Rosana unavail.)*
Green Needlegrass	1.0-1.5	4-6	*Lodorm*
Basin Wildrye	0.8-1.2	2-4	*Trailhead*
Legumes			
Yellow-flowered Alfalfa	0.5-0.7	2-4	*Pre-inoculated var. falcata*
American Vetch	0.4-0.6	<1	
Other Forbs			
Blue Flax	0.2-0.3	1-3	*Native origin*
*Western Yarrow	0.2-0.4	17-21	*N. Am. origin*
Prairie Coneflower	0.4-0.6	9-11	
Shrubs and Subshrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Greasewood[2]	1.3-1.7	7-10	*Must be de-winged*
*Winterfat	0.4-0.6	<1	
*Wyoming Big Sagebrush	1.5-2.5	82-138	
Gardner Saltbush[2]	0.4-0.6	1	*Must be de-winged*
Fourwing saltbush[2]	0.8-1.2	1-2	*Must be de-winged*

This mix can be applied at once with grassland-type broadcaster. Or, the heavy and light seed can be spatially segregated, BUT THEY MUST BE ORDERED IN SEPARATE BAGS. S**pecies denoted by an asterisk* are suitable for broadcast seeding.** Alfalfa can also be broadcast seeded.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood, Gardner Saltbush, and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #13b

Upland Shrub-Steppe Seed Mix
Lower Slope Positions, Lesser Slope Gradients, Soil Deposition Areas
Allowed Alternative Species*

Grasses, Cool-Season	*Preferred Cultivar*[1]
Thickspike wheatgrass	*Critana*
Big Bluegrass	*Sherman*

Forbs
Any one forb may be omitted.
Echinacea angustifolia

Subshrubs
Fringed Sagewort

Shrubs
Any one shrub/subshrub other than big sagebrush may be omitted. If seed of suitable origin for some shrubs is unavailable, additional seed of another available shrub may be increased to compensate for the reduction.

* These species will be seeded at a rate to correspond to the effective seeding rate of the species they replace in the basic mix.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #13c

Upland Shrub-Steppe
All Isolated Shrub Mosaics and Chemical Fallow Areas

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Sandberg Bluegrass	0.4-0.6	9-11	*Mtn. Home, High Plains*, MT-1
Prairie Junegrass	1.0-1.5	53-80	*Native not Barkoel*
Grasses, Warm-Season			
Alkali Sacation	0.5-0.8	20-32	
Blue Grama	0.8-1.2	17-21	*Birdseye, Bad River*
Sand Dropseed	0.4-0.6	55-65	
Forbs			
Prairie Coneflower	0.8-1.2	23-34	
Scarlet Globemallow	0.1-0.2	1-2	
Western Yarrow	0.2-0.4	17-21	*N. Am. Origin*
Echinacea angustifolia	0.3-0.5	0-1	
Subshrubs			
Fringed Sagewort	0.2-0.3	20-30	
Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Winterfat	0.4-0.6	<1	
Wyoming Big Sagebrush	2.75-3.25	150-180	
Rubber Rabbitbrush	0.8-1.2	7-11	*Must be defuzzed*

This mix is intended to be **broadcast seeded** at approximately 10.5 pounds PLS/acre on calm to slightly breezy days using fertilizer (ammonium nitrate), cracked corn, or rice hulls as a carrier. Overfilling the hopper may result in "bridging." Some compaction or light harrowing is usually desirable following broadcast seeding, depending upon seedbed condition. Up to two species can be omitted from this seed mix based on price and availability.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #13d

Upland Shrub-Steppe
Mid-Upper Slope Positions, Greater Slope Gradients, Erosional Loss Areas

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Slender Wheatgrass	0.4-0.6	1-2	*Pryor, Revenue, or First Strike*
Thickspike Wheatgrass	0.8-1.2	3-4	*Critana*
Western Wheatgrass	0.8-1.2	2-3	*Rosana (Recovery if Rosana unavail.)*
*Big Bluegrass	0.8-1.2	16-24	*Sherman*
*Sandberg Bluegrass	0.4-0.6	8-13	*Mtn. Home, High Plains, MT-1*
Bluebunch Whtgrss, 2 vars.	2.5-3.0	8-10	*Secar and Discovery, P-7, or Anatone*
Legumes			
Yellow-flowered Alfalfa	0.4-0.6	2-3	*Pre-inoculated var. falcata*
Other Forbs			
*Western Yarrow	0.2-0.4	13-26	*N. Am. origin*
Blanketflower	0.4-0.6	1-2	
Annual Sunflower	0.6-1.0	1	
Subshrubs and Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
*Winterfat	0.8-1.2	2-3	
Black Greasewood[2]	1.3-1.7	7-10	*Must be de-winged*
*Wyoming Big Sagebrush	1.5-2.5	82-138	
Fourwing saltbush[2]	0.8-1.2	1-2	*Must be de-winged*

This mix can be applied at once with grassland-type broadcast seeder. Or, the heavy and light seed can be spatially separated, but THEY SEED MUST BE ORDERED IN SEPARATE BAGS. S**pecies denoted by an asterisk*are suitable for broadcast seeding.** Alfalfa may also be broadcast seeded. Drill seed the rest.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #13e

Upland Shrub-Steppe
Mid-Upper Slope Positions, Greater Slope Gradients, Erosional Loss Areas
Allowed Alternative Species*

Grasses, Cool-Season	*Preferred Cultivar*[1]
Basin Wildrye	*Trailhead*

Forbs

Blue Flax at no more than ¼ pound per acre *Echinacea angustifolia*	*N. Am. origin*

Subshrubs
Fringed Sagewort

Shrubs If seed of suitable origin for some shrubs is unavailable, additional seed of another available shrub may be increased to compensate for the reduction.

Rubber Rabbitbrush	*Must be defuzzed*

* These species will be seeded at a rate to correspond to the effective seeding rate of the species they replace in the basic mix.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #13f

Upland Shrub-Steppe
Repair Area Mix

Seeding Species	Approximate Rates (PLS#/A)	Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Western Wheatgrass	2.5-3.0	6-7	*Rosana (Recovery if Rosana unavail.)*
Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Black Greasewood[2]	2.0-2.5	138-172	*Must be de-winged*
Fourwing Saltbush[2]	2.5-2.0	2-2.4	*Must be de-winged*
Wyoming Big Sagebrush	1.5-2.5	82-138	

This repair mix is for failed seedings where weeds limit further seeding success. Weed control and litter reduction is prerequisite. Drill seed the heavy potion of this mix with no-till preferred. It uses the unique property of Rosana western wheatgrass to spread vigorously via rhizomes and still gives a decent chance of producing shrubs.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing WY Big Sagebrush PLS rate depending on the desired revegetation result.

Seed Mix #14

Temporary Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Western Wheatgrass	2-3	5-8	*Rosana (Recovery if Rosana unavail.)*
Thickspike Wheatgrass	2-3	8-12	*Critana*
Slender Wheatgrass	1-1.5	4-6	*Pryor, Revenue, or First Strike*
Legumes			
Yellow-flower Alfalfa	1.5-2	7-10	*Medicago sativa var. falcata*

This seed mix is intended for drill seeding at a little more than 7.5 pounds per acre or broadcast and harrowed, preferably followed by packer wheels, at roughly 11 pounds PLS/acre.

These species are always available. However, a rhizomatous alfalfa may be substituted if less persistence is desired.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #15

Steppe Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Western Wheatgrass *unavail.)*	1.4-2.0	3-4	*Rosana (Recovery if Rosana*
Thickspike Wheatgrass	1.0-1.5	4-5	*Critana*
Basin Wildrye	0.8-1.2	2-4	*Trailhead*
*Big Bluegrass	0.4-0.6	8-12	*Sherman*
Legumes			
Yellow-flowered Alfalfa	0.6-0.8	3-4	*Pre-inoculated var. falcata*
American Vetch	0.4-0.6	<1	
Forbs			
Prairie Coneflower	0.4-0.6	2-3	
Annual Sunflower	0.4-0.6	0-1	
*Western Yarrow	0.2-0.4	17-21	*N. Am. origin*
Subshrubs and Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Black Greasewood[2]	1.3-1.7	7-10	*Must be de-winged*
*Winterfat	0.4-0.6	<1	
*Wyoming Big Sagebrush	0.3-0.5	17-29	
*Rubber Rabbitbrush	0.3-0.5	3-5	*Must be defuzzed*
Fourwing saltbush[2]	0.8-1.2	1-2	*Must be de-winged*

This mix can be applied with a Grasslander rangeland seeder, or, heavy-seeds can be drill-seeded while by broadcasting the remaining species BUT THE SEED MUST BE ORDERED IN SEPARATE BAGS. Species suitable for broadcasting are **denoted by an asterisk*.**

Seed Mix #15 comprises a diverse mix of species. Up to two nonwoody and one woody species can be omitted without substitution.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #15a

Steppe Interseeding Seed Mix

Interseeding can be implemented using only the heavy-seeded component of seed mix 15 plus sagebrush using a no-till drill or equivalent. That component is listed below:

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Cool-Season			
Basin Wildrye	0.8-1.2	2-4	*Trailhead*
Western Wheatgrass	2.0-3.0	3-4	*Rosana*
Thickspike Wheatgrass	1.0-1.5	4-5	*Critana*
Legumes			
Yellow-flowered Alfalfa	0.6-0.9	3-4	*Pre-inoculated var. falcata*
Forbs			
Prairie Coneflower	0.4-0.6	2-3	
Echinacea angustifolia	0.3-0.5	1	
Subshrubs and Shrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Fourwing Saltbush[2]	0.4-0.6	<1	*Must be de-winged*
Greasewood[2]	0.6-0.9	3-5	*Must be de-winged*
Wyoming Big Sagebrush	0.4-0.6	2-3	

Drill seeding is preferred but the Grasslander is acceptable. Where annual bromes are abundant, chemical fallow or annual control is important. Thatch removal may be necessary so the drill disc cuts into earth.

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #16

Suitable Spoil Seed Mix

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Warm-Season			
*Alkali sacaton	0.8-1.2	32-48	
Grasses, Cool-Season			
Western Wheatgrass	2.0-2.5	6-8	*Rosana*
Indian ricegrass	1.3-1.7	4-5	*Rimrock*
Slender Wheatgrass	1.3-1.7	5-6	*Pryor, Revenue, or First Strike*
Snake River or BB Whtgrs	0.8-1.2	3-4	*Discovery, Anatone, Goldar*
Legumes			
Purple Prairie Clover	0.4-0.6	3-5	*Bismark*
Yellow-flowered Alfalfa	0.4-0.6	1-3	*Pre-inoculated var. falcata*
Other Forbs			
*Yarrow	0.2-0.4	12-25	*Native origin*
Annual Sunflower	0.5-1.0	0-1	
Blue Flax	0.2-0.3	1-2	*Native origin*
Shrubs & Subshrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
Fourwing Saltbush[2]	1.3-1.7	2-3	*Must be de-winged*
*Wyoming Big Sagebrush	0.5-1.5	29-86	
Greasewood[2]	1.8-2.2	10-12	*Must be de-winged*
Gardner Saltbush[2]	0.8-1.2	2-3	*Must be de-winged*

Drill-seeding heavy seed seems to be most effective in spoil, whereas crusting limits the establishment of light-seeded species. If heavy- and light-seeded seeds are planted by a combination of drill and broadcast seeding, THE SEED MUST BE ORDERED IN SEPARATE BAGS. **Species suitable for broadcast seeding are denoted by an asterisk*.**

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

[2]Greaswood, Gardner Saltbush, and Fourwing saltbush are heavier seeded shrubs. SCM can omit or reduce the PLS rate for one or both of these heavier seeded shrubs while increasing one or more light seeded shrubs PLS rates depending on the desired revegetation result.

Seed Mix #16a

Suitable Spoil Interseeding Seed Mix

Interseeding light-seeded species has had little success in spoil, probably due to soil crusting. If a seeding failure occurs that is not caused by substrate, drill seed just the heavy-seeded species in Mix 16.

Seed Mix #16b

Suitable Spoil
Allowed Alternative Species*

	Preferred Cultivar[1]
Grasses, Cool-Season	
Basin Wildrye	*Trailhead*
Big Bluegrass	*Sherman*

Forbs
With six forbs including legumes, one may be omitted

Subshrubs
Fringed Sagewort

Shrubs If seed of suitable origin for some shrubs is unavailable, additional seed of another available shrub may be increased to compensate for the reduction.

Rubber Rabbitbrush	*Must be defuzzed*

* These species will be seeded at a rate to correspond to the effective seeding rate of the species they replace in the basic mix.

Seed Mix #17

Sagebrush-Forb Mosaic Seed Mix

Availability and price vary widely among years. Up to 3 nonwoody species may be deleted or added for special substrates or depending upon availability and price.

Species	Seeding Rates (PLS#/A)	Approximate Seeds/Sq. Ft. +- 10%	*Preferred Cultivar*[1]
Grasses, Warm-Season			
*Alkali Sacaton	0.6-0.8	24-32	
*Sand Dropseed	0.2-0.4	24-49	
Grasses, Cool-Season			
Snake River or BB Whtgrs	1.3-1.7	4-6	*Secar, P-7 germ, Anatone, Discovery*
Indian Ricegrass	0.8-1.2	3-4	*Rimrock, Nezpar*
*Prairie Junegrass	0.4-0.6	21-32	*Not Barkoel*
Legumes			
American Vetch	0.4-0.6	0.3-0.5	
*White Prairie Clover	0.4-0.6	3-5	*Antelope or other*
Purple Prairie Clover	0.4-0.6	2-3	*Bismark*
Yellow-flowered Alfalfa	0.4-0.6	2-3	*Pre-inoculated var. falcata*
Other Forbs			
*Western Yarrow	0.2-0.4	17-21	*N. Am. Origin*
Annual Sunflower	0.4-0.6	0-1	
*Prairie Coneflower	0.8-1.2	23-34	
*Tanseyleaf Tansyaster	0.3-0.5	4-6	*Target on coarse scoria*
Echinacea angustifolia	0.3-0.5	1	
Blanket Flower	0.8-1.2	2-4	
*Scarlet Globemallow	0.1-0.2	1-2	
Shrubs & Subshrubs (Northern Plains origin desired for all shrubs, esp. sagebrush.)			
*Fringed Sagewort	0.2-0.3	20-30	
*Cudweed sagewort	0.2-0.3	20-30	
*Wyoming Big Sagebrush	2.5-3.0	140-170	
*Silver Sagebrush	1.4-1.6	27-31	*Plains not mountain origin*
*Rubber Rabbitbrush	0.4-0.6	4-6	*Must be defuzzed*

[1] Proven adapted varieties or geographic origin similar to the mine, but not strictly stipulated due to uncertain availability.

Seed Mix #17 Continued

This seed mix is intended to be seeded on generic coversoil through a combination of drill seeding the heavy seed and broadcasting the light seed.

On scoria, the entire mix from a single set of bags can be broadcast although two passes may be required due to the high seeding rate. The broadcast seeder should be followed by a fairly aggressive rake harrow to place seed within the scoria matrix.

All broadcast seeding denoted by "*" should be limited to calm days. The higher the point of seed dissemination, the more influential (detrimental) the wind.

This is a difficult seed mix to establish by its very nature. It's short on strong establishers that would conflict with the sagebrush and forbs. Forbs are by nature poorly represented at the Spring Creek Mine and many are ephemeral. Be careful not to bury the forb seed too deep.