Butte Reclamation Evaluation System (BRES)

Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

March 2006

Prepared for:

U.S. Environmental Protection Agency




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RESPONSE ACTION CONTRACT
FOR REMEDIAL, ENFORCEMENT OVERSIGHT, AND NON-TIME
CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR
THREATENED RELEASE OF HAZARDOUS SUBSTANCES
IN EPA REGION VIII

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FINAL DRAFT
BUTTE RECLAMATION EVALUATION SYSTEM (BRES)
BUTTE PRIORITY SOILS OPERABLE UNIT
SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE, MONTANA

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Abbreviations and Acronyms

ARARs	applicable or relevant and appropriate requirements
AR	Atlantic Richfield
ARCO	Atlantic Richfield Company
BHRS	Butte Hill Revegetation Specifications
BLM	Bureau of Land Management
BMP	best management practice
BPSOU	Butte Priority Soils Operable Unit
BRES	Butte Reclamation Evaluation System
BSB County	Butte-Silver Bow County
BSBRS	Butte-Silver Bow County Revegetation Standards
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act, as amended
CTEC	Citizen's Technical Environmental Committee
COC	contaminant of concern
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSPRA	field survey of previously reclaimed areas
FSUA	field survey of unreclaimed areas
GIS	Geographic Information System
GPS	Global Positioning System
LAO	Lower Area One
MDEQ	Montana Department of Environmental Quality
MERDI	Montana Economic Revitalization and Development Institute
mg/kg	milligrams per kilogram
m^2	square meter
NPL	National Priorities List
N-TCRA	non-time critical removal action
OU	operable unit
O&M	operation and maintenance
RAOs	remedial action objectives
RGs	remedial goals
PRP	Potentially Responsible Party
QC	quality control
RASD	response action summary document
RI	reclamation improvement
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RRU	Reclamation Research Unit
SAP	sampling and analysis plan

TCRA	time-critical removal action
UWS	undesirable weedy species
VI	vegetation improvement

Executive Summary

Land reclamation has been, and will continue to be, a vital component of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions implemented at the Butte Priority Soils Operable Unit (BPSOU). Response actions may also involve a variety of engineering applications including storm water controls, caps over mine waste, and waste removals. The Butte Reclamation Evaluation System (BRES) is the result of the U.S. Environmental Protection Agency's (EPA's) recognition of the need for a formalized assessment tool to evaluate the stability, integrity, and continued protection of human health and the environment attained by land reclamation over the long term. As specified in the record of decision (ROD), the BRES (i.e., this document) sets the performance standard that all reclaimed areas in the BPSOU must achieve, the methodology for evaluating these reclaimed areas, and guidelines for corrective actions.

One important response action technology at the BPSOU is the construction of caps over waste areas or contaminated areas. An erosive cap is unstable and impermanent. If the cover soil comprising the cap erodes to a point where waste material is exposed, contaminants of concern (COCs) may be transported off-site by water or wind, and may come into contact with human or environmental receptors on the site. The BRES describes quantifiable evaluation criteria (e.g., vegetation cover, erosional condition, gullies, etc.) that must be achieved and maintained on reclaimed areas to ensure protectiveness. The periodic evaluation of reclaimed sites against the BRES performance standard will direct the appropriate types of corrective actions that may be needed at each site.

The BRES is specifically designed for use in the upland environment in Butte, Montana. To accommodate the diverse land types and end land uses within the BPSOU, the BRES is designed to address reclaimed uplands in residential, recreational, and commercial/industrial land settings. However, residential yards, and playgrounds are specifically excluded from the BRES. The BRES has components that allow it to be applied to areas reclaimed as open space within this urban setting.

During the 2001 field season, EPA, with input from the stakeholder Technical Group, calibrated and validated the Draft BRES (CDM Federal Programs Corporation [CDM]/Reclamation Research Unit [RRU] 2003) so that the system would be ready for use upon issuance of the ROD. This process involved evaluating a select number of sites, identifying the level of training required of field personnel to obtain precise (i.e., reproducible) results, refining methods and procedures, and identifying relevant reclamation performance standards. The BRES Calibration and Validation Report (CDM/RRU 2003) describes that process in detail. Now that it has been validated and calibrated for use on remediated sites at the BPSOU, the BRES provides the means for representatives of EPA, Montana Department of Environmental Quality (MDEQ), the Potentially Responsible Party (PRP) Group, consultants, and others to determine if these lands are being maintained at a level consistent with remedial objectives.

The BRES program described herein meets EPA's goals of having an assessment tool that:

- Emphasizes soil and vegetation parameters critical to maintaining site stability, integrity, and overall protectiveness of the remedy
- Can be easily and quickly applied in the field to evaluate the large number of sites
- Utilizes a minimum amount of equipment
- Is simple to learn by new evaluators
- Provides precise (i.e., reproducible) results when applied by different evaluators

This document describes the overall BRES program, which includes the components of the BRES, how the BRES should be applied in the field, and how the BRES fits into the long-term operation and maintenance, which includes tracking, monitoring, and maintenance of reclaimed sites at the BPSOU.

EPA has identified six preparatory activities that should be completed prior to field evaluation of reclaimed sites using the BRES:

- Finalizing the list of response action sites that will be included in the BRES program
- Obtaining new low-level aerial photographs for use during BRES assessments
- Delineating discrete polygons where appropriate within remediated sites for evaluation under the BRES
- Completing the BRES Field Manual
- Fine tuning the engineered cap integrity checklist/evaluation process based on field experience
- Designing and implementing a data management strategy to ensure accurate and complete tracking of BRES information

Section 1 Overview

1.1 Introduction

In the ROD, EPA specifies that the BRES is a performance standard that reclaimed areas in the BPSOU must achieve. The BRES is an evaluation tool developed to ensure the integrity of most reclaimed lands, including soil cover caps or other forms of engineered caps covering mine-waste material left-in-place. These caps must perform at a level that maintains long-term protection of human health and the environment and otherwise complies with performance standards at the BPSOU.

It is important to understand that the BRES is not an operation and maintenance (O&M) plan. The BRES sets forth the performance standard that reclaimed areas must achieve. The BRES also provides the methodology to guide the evaluation of the reclamation against the performance standard. The periodic evaluation of reclaimed sites against the BRES performance standard will direct the appropriate level of corrective action work that may be needed at each site.

BRES-directed corrective action work may simply be some type of typical O&M, such as vegetation improvements (VI) or repair of actively eroding gullies. However, corrective action may also involve full and complete reclamation of a response action site. This BRES-directed corrective action work differs from more "conventional" O&M (e.g., controlling access, maintenance of fences, weed spraying, litter control, etc.) because the corrective action is directed specifically at maintaining cap integrity. Conventional O&M activities will be outlined in a separate O&M plan.

The BPSOU is one of three remedial OUs identified by EPA within the Butte Area portion of the Silver Bow Creek/Butte Area National Priorities List (NPL) site within and near Butte, Montana. The OU consists of historic mining sites situated entirely within an urban setting, encompassing much of the cities of Butte and Walkerville. Mine waste and mill tailings accumulated from over 100 years of mining are dispersed throughout the OU, posing health risks to human and ecological receptors.

Soon after Butte was named a Superfund site, EPA recognized that arsenic- and lead-contaminated wastes within the populated urban area of Butte presented health risks. As a result, numerous response actions (Non-Time Critical Removal Actions [N-TCRAs] and Time Critical Removal Actions [TCRAs]) were implemented beginning in 1988 and continuing through the Remedial Investigation/Feasibility Study (RI/FS) process leading up to the ROD. Over 400 acres of land within the BPSOU were addressed through response actions prior to the ROD. The RI/FS determined that, in most cases, source controls, capping, and land reclamation techniques used during response actions to address contaminated solid media were consistent with the long-term remedial goals for the site and adopted most of the response actions as a portion of the remedy for contaminated solid media at the BPSOU.

Reclamation in Butte evolved over time as factors controlling reclamation success were better understood and implementation practices improved. Response actions taken for mine-impacted lands within the BPSOU involved a variety of engineering applications, including storm water controls, caps over mine waste, and removals. The remedial investigation report identified 182 mining-related sites that have been impacted by or represent potential sources of arsenic and metal contaminants within the BPSOU (PRP Group 2002). While most of these sites have been addressed under EPA-sanctioned response actions prior to the ROD, cap integrity and vegetation response at the BPSOU have been inconsistent, due in part to the variations in the procedures and practices used by the various entities to reclaim these sites. These entities have included the EPA, Atlantic Richfield (AR), MDEQ, and former state agencies.

Recognizing the need to evaluate the stability, integrity, and degree of protection attained by reclamation, EPA began formally evaluating these lands in 1992. Since then, EPA has conducted land reclamation assessments in Butte, Anaconda, and at a variety of sites throughout the Clark Fork River Basin of Montana. During this period, several soil and vegetation parameters were used to provide data and information regarding the efficacy of reclamation efforts on these mine lands. From this work, EPA recognized the need for a formalized evaluation tool that would allow agency personnel to determine whether sites were meeting the remedial goals and if that trend was likely to continue. EPA requirements for such a tool are that it must:

- Emphasize soil and vegetation parameters critical to maintaining site stability, integrity, and overall protectiveness;
- Be easily and quickly applied in the field due to the large number of sites that need to be evaluated;
- Utilize a minimum amount of equipment;
- Be simple to learn by new evaluators; and
- Provide precise (i.e., reproducible) results when applied by different evaluators.

The BRES is the resulting formalized assessment tool to evaluate the performance standard compliance, stability, integrity, and protectiveness attained by reclamation within the urban upland environment in Butte. The methodology was first proposed in the initial draft BRES document (CDM/RRU 2000) and discussed at a public meeting of interested stakeholders in September 2000. At the meeting, EPA received written comments on the BRES from the MDEQ, AR, Big Butte Biologic Compost, Bighorn Environmental, Butte-Silver Bow (BSB) County, the Citizens Technical Environmental Committee (CTEC), and the Natural Resource Conservation Service. EPA was pleased with the number and quality of constructive stakeholder comments and responded formally to each comment in a document entitled *EPA Responses to Comments Received on the Butte Evaluation System Revision 0 Dated August 15, 2000*

(CDM 2001). Since then, the BRES has been further refined for use with the BPSOU ROD

The BRES is specifically designed for use in Butte. To accommodate the diverse land types and end land use within the BPSOU, the BRES is designed to address residential, recreational, and commercial/industrial land uses. Residential yards and playgrounds are specifically excluded. The system also has components that allow it to be applied to areas reclaimed as open space within the upland urban setting.

1.2 Regulatory, Removal, and Reclamation History

In 1991, EPA developed the Statement of Work for the BPSOU RI/FS (CDM 1991). The RI/FS was separated into two phases: Phase I and Phase II, which were to be implemented concurrently. Phase I tasks focused on mine wastes and contaminated soils within residential areas and in adjacent and upgradient contaminant source areas within the OU where the potential for human health impacts from exposure to contaminants was greatest. Phase II focused on an evaluation of the characteristics and impacts of metals and arsenic contamination on Silver Bow Creek, and on other source materials located outside of residential areas.

In 1994, the Montana Natural Resource Information System produced Map 94ARCO68 that compiled all of the facilities and source areas that had been identified within the BPSOU by EPA, State Agencies, BSB County and other entities comprising the PRP Group. Map 94ARCO68 depicts the reclamation status of the BPSOU (unreclaimed areas and areas where reclamation/removal activities had been completed) through 1993. This map served as the basis for further site characterization and reclamation work during the Phase II BPSOU Remedial Investigation.

In 1996, EPA approved the Final Phase II RI/FS Work Plan and Addendum for the BPSOU (PRP Group 1996a). This document presented a plan to build upon the soil/waste characterization and removal reclamation work that had been compiled on Map 94ARCO68. The goal for the Phase II RI/FS Soil/Mine Waste Investigation was to fully characterize the BPSOU with respect to contaminated soil and waste material. To accomplish this goal, EPA, together with the State and the PRP Group, conducted the field survey of unreclaimed areas (FSUA) and the field survey of previously reclaimed areas (FSPRA).

The FSUA was conducted to complete the site characterization with respect to unreclaimed land within the BPSOU (outside of residential areas) and identify those source areas that exceed arsenic and/or lead removal action levels for removal/reclamation. The FSUA integrated previously-collected analytical data with new analytical data and observations to identify source areas that exceed action level lead and/or arsenic concentrations and areas that may potentially impact surface water quality through erosion and off-site sediment transport.

Previously reclaimed sites were evaluated as part of the FSPRA. The goal of the FSPRA was to evaluate all the facilities/source areas identified as “reclaimed” on Map

94ARCO68 to determine whether these sites were adequately reclaimed for the purposes of final remediation at the BPSOU. The work plan specified that:

- Those facilities/source areas that are adequately reclaimed require only continued short-term O&M at this time.
- Those facilities/source areas that are inadequately reclaimed require additional reclamation prior to reverting to long-term monitoring and corrective action as appropriate.

The FSPRA evaluated previously reclaimed sites in accordance with reclamation protocol described in a document entitled *Field Survey of Previously Reclaimed Areas Site Inspection Protocol* (PRP Group 1996b). This document did not make final remedial action determinations for any site. Final remedial decisions regarding these areas are contained in the ROD. The response action summary document (RASD) and the feasibility study (FS) contained additional evaluation of the reclaimed areas.

Final summary documents for the FSUA and FSPRA were published in 1997 and include:

- Final Field Survey of Unreclaimed Areas Summary Report (CDM 1997)
- Technical Memorandum: Field Survey of Previously Reclaimed Areas (PRP Group 1997a)

The FSUA identified 27 unreclaimed sites with lead concentrations greater than the 2,300 mg/kg non-residential action level, and 32 sites with arsenic concentrations that exceeded the 500 mg/kg commercial action level for arsenic. Three of the sites that exceeded the commercial arsenic action level also exceeded the non-residential lead action level.

The FSPRA evaluated the condition of 95 reclaimed areas in 1996 and 1997. Twenty-nine sites evaluated during the FSPRA were identified as being inadequate with respect to the reclamation protocol and required further reclamation.

With the exception of seven sites slated to be addressed under the Montana Economic Revitalization and Development Institute (MERDI) Program, the PRP Group reclaimed all the sites that were identified in the FSUA with lead concentrations above 2,300 mg/kg and the previously reclaimed sites identified for additional reclamation during the FSPRA. This work was conducted under the two EPA-approved Response Action Work Plan Addenda for the Previously Reclaimed Areas Operation and Maintenance (PRP Group 1997b) and the 1997 Unreclaimed Areas (PRP Group 1997c). Reclamation was performed in accordance with the EPA-approved Butte Hill Revegetation Specifications (BHRS). Sites identified during the FSUA with arsenic concentrations above the arsenic action level (residential - 250 mg/kg; commercial - 500 mg/kg; and recreational [open space] - 1,000 mg/kg) may be removed or reclaimed as part of future response actions. Techniques and methods used to address these sites were evaluated in the FS.

1.3 Function of Butte Reclamation Evaluation System

This section describes the function of the BRES within the CERCLA regulatory framework set forth by EPA for the BPSOU. Other key components of the CERCLA process, with respect to the BPSOU, are also discussed.

Appendix A provides a flow chart that depicts the regulatory logic by which mine-impacted lands within the BPSOU were addressed prior to the ROD, and how performance standards set by the BRES will be used to maintain reclaimed sites after the ROD. This section further describes how response action sites within the BPSOU will be evaluated by the BRES to ensure that they are maintained at a level that will remain protective and otherwise comply with performance standards over the long-term.

1.3.1 The BRES Tool

The BRES is a tool that establishes detailed performance standards and the methodology used to evaluate the stability, integrity, and degree of human and environmental protectiveness afforded by EPA-sanctioned response actions implemented on lands impacted by mining within the BPSOU. The BRES will be used to continuously evaluate and maintain reclaimed and revegetated sites in perpetuity. Results from the application of the BRES will be used to trigger corrective actions that ensure the response actions are appropriately maintained.

1.3.2 Evaluation of Reclaimed and Unreclaimed Lands

As described in Section 1.1, the FSUA was implemented as part of the Phase II Remedial Investigation to identify and characterize all unreclaimed mine-impacted land within the BPSOU, and the FSPRA was implemented to evaluate all previously reclaimed land within the BPSOU. Unreclaimed sites that were identified in the FSUA with lead concentrations above the remedial goal (RG) of 2,300 mg/kg (excluding the MERDI properties), and previously reclaimed sites identified for additional reclamation during the FSPRA, were subsequently reclaimed in accordance with the BHRS. As a result of this process, all mine-impacted lands identified in the two documents within the BPSOU fall into one of the following three categories:

1. Current reclamation deemed protective for the short-term. Sites are designated for long-term monitoring and corrective action, as appropriate.

2. Unreclaimed site with lead concentration below the PRG (2,300 mg/kg). Sites in this category may exceed the arsenic removal action level and may contain elevated concentrations of other contaminants of concern (e.g., copper and zinc that may adversely impact surface water quality).

3. The site is one of seven MERDI properties.

The MERDI properties are slated for urban development under the MERDI program. Plans for the MERDI properties will be evaluated by EPA to ensure that these sites are developed in a fashion that complies with ARARs and provides for the long-term protection of human health and the environment.

Sites falling into categories 1 and 2 were evaluated in the RASD and the feasibility study (FS) to direct the selection of the final remedy for these sites in the ROD. The regulatory functions of the RASD, FS, ROD, and the BRES, in the context of mine-impacted lands at the BPSOU, are briefly described below.

1.3.3 Schedule

This Final BRES document describes the basis for the BRES and incorporates changes to the BRES methodologies based on stakeholder comments and the 2001 calibration and validation work conducted by the Technical Group. (This work is fully described in the Calibration and Validation Report [CDM/RRU 2003]). The final portion in the development of the BRES will be the preparation of a field manual for use by the field team during BRES evaluations. The BRES Field Manual will be developed after the finalization of the ROD and will be appended to this BRES document. Polygon delineation at BPSOU response action sites and database development (discussed in later sections) should commence immediately following the completion of the ROD.

Section 2 Goals, Objectives, and Standards

2.1 BRES Goals and Objectives

The BRES is identified in the ROD as the program used to evaluate the integrity of all reclaimed land, soil cover caps, or other forms of engineered caps covering mine-waste material left-in-place at the BPSOU. This system establishes evaluation procedures for performance standards to direct the long-term monitoring and corrective action of response actions to which it applies. The BRES will ensure that response actions and future remedial actions are maintained at a level that provides for the continuous protection of human health and the environment and compliance with ARARs.

EPA's goal is to have a reclamation evaluation procedure that can quickly, consistently, and cost-effectively identify areas of current or imminent reclamation failure, and determine what specific actions are required to remediate those areas to acceptable condition. Several attempts have been made by various entities to establish reclamation performance standards and a methodology to evaluate response action sites at the BPSOU, including draft versions of the BRES. After consideration of comments on previous drafts and evaluation of on-the-ground experience, the BRES is EPA's final determination regarding a necessary and appropriate evaluation system.

The BRES is designed to facilitate the collection of precise (repeatable) information by persons with experience in ecological and soil erosion assessment techniques. The system enables the assessors to quickly collect information that describes post-reclamation conditions with a minimal amount of field equipment. The BRES includes a field training program and a field manual with example photographs to guide the field crew. The system also incorporates historic site data into the decision-making process.

2.2 Stakeholder Involvement

EPA realized during the initial meetings with the BSPOU stakeholders that their involvement and input during the development of the BRES was important and useful. During BRES development, stakeholder representatives from BSB County, ARCO, MDEQ, CTEC, and EPA were involved at two levels: technical and management. During this period, which included the calibration and validation process, the Technical Group identified evaluation parameters and developed site assessment methodologies while the Management Group provided guidance by establishing overarching objectives and considerations.

2.3 Data Quality Objectives

The data quality objective (DQO) process (EPA 2000) describes EPA's policy for describing project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. Using the DQO process consists of seven steps. The use of DQOs in the development of the BRES is discussed below.

Step 1: State the Problem

The purpose of this step is to describe the problem to be studied so that the focus of the study will be unambiguous.

Many mine waste areas containing elevated concentrations of contaminants of concern (COCs) have been addressed "in-place" at the BPSOU through response actions involving land reclamation techniques using coversoil caps and revegetation. These actions have been designed to cap and stabilize COCs such that they no longer pose threats to human health or the environment. At these sites, vegetated and engineered cap integrity is critical to ensuring waste does not become exposed. Monitoring and corrective action, as appropriate, of reclaimed areas at the BPSOU is required to ensure healthy stands of vegetation and to maintain the integrity of soil caps in perpetuity (EPA 1999b). Proactive monitoring of these areas and conducting the appropriate level of corrective action will therefore be required. With these issues in mind, EPA developed the BRES in conjunction with the stakeholder groups to address several problems related to these needs.

For this project, the planning for developing the BRES tool was conducted by EPA, the decision makers for the BPSOU, with support from their contractors, CDM and the RRU. Stakeholder input was received from BSB County, ARCO, MDEQ, and CTEC. These stakeholders will play vital roles for the use of the BRES, which includes future implementation, technical support, citizen advisory, funding, and agency oversight of the BRES.

This Final BRES was completed for incorporation into the ROD. However, certain specific components of the BRES (e.g., polygon delineation) will be developed and/or refined after the ROD as part of the remedial design activities at the BPSOU.

Step 2: Identify the Decision
The principal study question and the alternative actions are listed below.

Principal Study Question	Alternative Actions
Does the initial version of the BRES meet its intended goal to provide an objective and precise method for evaluating the long-term protectiveness of response actions at the BPSOU?	1. Recommend the use of the BRES without modification. 2. Work with the stakeholders to modify the BRES such that it meets the objective.

In working with the stakeholders during the initial phase of the BRES development, it was determined that the initial draft BRES methodology (CDM/RRU 2000) did not meet the intended goal, but could with appropriate modification. The stakeholders identified important questions that, once answered, would allow the BRES to meet the intended goal; these included:

- Were any changes needed to the list of BRES parameters?
- What methodology should be used to evaluate each parameter?
- How precise do field estimates need to be?
- What parameters were identified as trigger items (see below) and what metrics should be used to trigger additional response action?
- If action is recommended, what type of action will be required to bring the site up to an acceptable level?
- Should response action sites be evaluated as one unit or are there compelling reasons to divide sites up to better understand conditions and the need for additional action?
- What, if any, historical data or other information is available for a particular response action site that might make the decision-making process more efficient and thorough?

Step 3: Identify the Inputs to the Decision
Information and data required to answer the above questions include the following:

- Percent live cover data for desirable species, undesirable weedy species (UWS), noxious weeds, litter, and rocks greater than two inches on a site
- Identification of desirable species and weedy species that are dominant, frequent, and infrequent
- Identification of a precise erosion evaluation methodology (modified Bureau of Land Management [BLM] procedure with seven variables to score was used)
- Identification of a precise cover estimation methodology (an ocular technique was used in conjunction with quantitative point measurement verification to improve visual cover estimates and meet the precision goal)
- Identification of exposed mine waste (or the potential for waste to become exposed), site edge problems, bulk soil failure, land slumps, subsidence, barren areas, and/or gullies

To improve the precision (or repeatability) of BRES estimates, it is necessary to divide response action areas into smaller land units, called polygons. This will be accomplished by assessing the variability of vegetation cover, erosion, size and degree of barren areas, and land forms and land use throughout the response action site. The overall size of the response action site and the potential size of polygons were also evaluated (see Step 5 for a discussion on the metrics used to determine when polygon delineation is appropriate).

From the information variables listed above, maintenance action triggers were identified. Triggers are specific parameters and their associated metrics (see Step 5). Polygon-based trigger parameters are vegetation and erosion. These parameters are evaluated for the polygon as a whole. Localized trigger parameters, which initiate an action if they are observed anywhere in the polygon, are site edge problems, exposed waste material, bulk soil failure or mass instability, barren areas, or the presence of gullies. If a trigger is identified, the BRES logic diagrams for that trigger item (Appendix C) form the basis for decisions about required data or corrective action. When additional quantitative environmental data are required, the PRP Group will submit a site-specific sampling and analysis plan (SAP) to EPA.

Step 4: Define the Study Boundaries
The spatial boundaries of the BRES program encompass the upland BPSOU areas that have undergone response actions. The Geographic Information System (GIS) will serve as the tracking mechanism for the boundaries of the individual BRES sites. These boundaries were defined by a stakeholder group effort and will remain fixed unless site boundaries are changed as a result of the ROD or remedial design. Each response action area will be evaluated in terms of the need to delineate polygons. Polygon boundary delineation will occur over several years (i.e., it will take several years because of the large number of sites) and the boundaries will remain fixed; however, boundaries can be changed after two full BRES evaluation periods (i.e., after eight years). Boundary alteration is discussed in Section 4.1.3. It is recommended that site evaluations occur between mid-late June and early August.

Step 5: Develop a Decision Rule
The primary BRES decision rule involves determining whether a response action site requires corrective action. During the 2001 calibration and validation process, EPA and the other stakeholders customized the BRES so that this decision could be made with known accuracy and precision. This step of the DQOs identifies and discusses:

1. Parameters that were developed to characterize response action sites in terms of meeting human health and environmental risk objectives and performance standards

2. Metrics ("action levels" in DQO parlance) used for each parameter that collectively go into the corrective action decision

3. Accuracy and precision in making parameter estimations and corrective action decisions

The BRES parameters and their associated metrics were refined by the stakeholders in the field during the 2001 calibration and validation process. All potentially useful parameters were evaluated during this process and many different metrics were used before the stakeholders felt the system was calibrated and would provide accurate and precise information for use in making corrective action decisions. See Section 7 and the Calibration and Validation Report (CDM/RRU 2003) for more detailed discussion on this process.

The parameters deemed appropriate by EPA and the stakeholders during the development of the BRES are vegetation cover, erosion, the presence of gullies or exposed waste material, the condition of site edges, and the existence of barren areas (see BRES field evaluation form [Appendix D]). The BRES evaluation contains decision diagrams (Appendix C) to help evaluators determine what additional data are required or what corrective action should be taken for a particular site. The diagrams apply decision rules for the key parameters (i.e., the trigger items); these are briefly discussed below and detailed discussions are provided in Section 7.

Vegetation Cover
In accordance with the Strip and Underground Mine Reclamation Act, SS 82-4-201 through 82-4-254, MCA, the BRES must ensure that vegetated cover soil caps and other reclaimed lands within the BPSOU support a diverse plant community including native species to the extent that the constituents of the vegetation cover are not incompatible with the performance of the remedy.

1. For polygons that fall in the lowest live vegetation cover category (less than 21 percent), the technical recommendation is that the site undergo either vegetation or reclamation improvement (VI or RI). If a site undergoes VI, and then falls into the less than 21 percent live cover category again during the next BRES evaluation, the polygon is then required to undergo RI in order to meet the BHRS.

2. For polygons that fall into the middle live vegetation cover category (21-40 percent), UWS are considered. If greater than 10 percent of the polygon is covered by UWS, then a recommendation will be made that VI be implemented on the polygon. If less than 10 percent of the area of the polygon is covered by UWS, then the polygon should undergo a regularly-scheduled BRES evaluation in four years.

3. Polygons that fall into the upper vegetation cover category (41-100 percent) should be re-evaluated in four years.

Erosion
If the erosion evaluation score is 55 or less, no immediate action is required and the polygon will continue on the regular BRES evaluation schedule of every four years. A score of greater than 55 triggers a recommendation for corrective action. The need for an engineering assessment and O&M plan are discussed in Section 7.

Gullies
If a gully exists within a polygon, it should be noted on the field evaluation form whether the gully is actively eroding or healing. If the gully is healing as defined by the BRES, no immediate action is required and the polygon will continue on the regular BRES evaluation schedule of every four years. Action is recommended for actively eroding gullies. The engineering assessment, corrective action plan, construction schedule, and further evaluations are discussed in Section 7

Exposed Waste Material
If there is exposed waste on a site, it triggers a recommendation for action. Signs of bulk soil failure or land slumps also trigger a recommendation for action. An engineering assessment should be performed on these areas to determine the appropriate type of corrective action needed to repair the cap.

Site Edges
The site edge trigger parameter is primarily for monitoring purposes, except when gullies or exposed waste materials are present. As previously described, for these circumstances, the recommendation is for corrective action to repair the gully, and for removal or covering of exposed waste material. If neither gullies nor exposed waste exist, yet a significant difference is identified between the site edge and the site interior, then the area should be tracked in the GIS and O&M databases for future trend analysis to determine whether site edge condition is improving or declining. These sites should undergo a regularly-scheduled BRES evaluation in four years, which must include the entire polygon, not just the barren areas.

Barren Areas
If barren area(s) are located within a polygon, but cover less than 25 percent of the polygon, a VI plan and/or a RI plan must be developed to repair only the barren area(s). If a VI plan is implemented and the next BRES evaluation at the site indicates that the VI actions failed, the barren area(s) must be addressed according to the BHRS. If barren area(s) cover 25 percent or more of a polygon, the same decision logic is used, except that the VI plan and/or RI plan must include the entire polygon, not just the barren area(s). If a VI plan is implemented and the next BRES evaluation indicates that the VI actions fail, a RI plan must be developed and approved and the entire polygon must then be brought up to the BHRS.

Under each of the above circumstances, corrective action work must be completed within a calendar year of the BRES evaluation and the polygon should then undergo a full BRES evaluation three years following completion of the corrective action work (e.g., four years after the initial BRES assessment).

Step 6: Specify Tolerable Limits on Decision Errors
General sources of potential errors in using the BRES involve the inexperience of novice field crew members. These types of errors will be brought within tolerable limits by 1) selecting crew members with experience with this type of environmental assessment, and 2) conducting an annual training program on all aspects of the BRES. Decision errors that can occur during the collection of cover and erosion data are recognized, and procedures are therefore built into to BRES to meet tolerable limits for these types of data. The method of training field crews to estimate cover and the selection of cover classes (e.g., 21-39 percent live vegetation cover) were chosen to hold decision errors within tolerable limits. During training sessions, the field crew's ability to precisely estimate cover is repeatedly tested by comparing visual estimates to quantitative measures of cover. Once field crew members can repeatedly estimate

vegetation cover to within ±10 percent of the measured value, the tolerable limit has been met and the vegetation portion of the training is complete.

During the initial erosional condition training session field crew members will calibrate themselves by scoring erosional condition on different BRES polygons using the BRES Erosion Condition Class Determination guidelines (BLM 1981), and then comparing individual scores with one another. Once the field crew can reliably rank erosional condition within ±10 percent of the group mean, the tolerable limit for erosion estimating has been met and the erosion evaluation portion of the training is considered complete.

Step 7: Optimize the Design
The BRES procedure described in the initial BRES document (CDM/RRU 2000) was optimized during the 2001 field calibration and validation work. System design was optimized to increase field worker efficiency in pre-assessment preparation, field data collection precision, and decision making logic. Training sessions to optimize the precision of field crew members are necessary. Pre-assessment preparation supplies field personnel with available GIS information pertinent to the field survey, including an aerial photograph with site boundaries highlighted. The field form includes spaces for pertinent data, which is quick and easy to collect. The BRES includes a field manual that summarizes the BRES methodology so that it is easy to use in the field. To the extent possible, data should be collected and stored electronically in the field to minimize post-field data entry. The decision logic diagrams clearly indicate actions required at sites found to require corrective action.

Further refinement of the BRES design will occur as polygon delineation is completed and the database is developed.

2.4 Criteria, Standards, and Goals

Existing criteria, standards, and goals were incorporated into the design of the BRES. The BRES was built around RAOs for contaminated solid media and RGs (as described in the final ROD), as well as the BHRSs (Appendix B), the Butte-Silver Bow County Revegetation Standards (BSBRS) (BSB 1995a, b; BSB 1996), and reclamation and revegetation ARARs.

2.5 Summary of BRES Calibration/Validation Activities

BPSOU stakeholders were involved in the 2001 field BRES calibration and validation effort at two levels, the technical level and the management level. Both groups provided input into the calibration and validation process.

Two overarching goals were identified for the calibration and validation field season. These were to: (1) develop a system that can accommodate the environmental variability within sites and adequately describe (to management) the conditions at a site, and (2) formalize the decision-making process in terms of the recommended maintenance of vegetated caps. The Technical Group worked interactively during 2001 to verify the BRES evaluation parameters in the Draft BRES document and to calibrate and validate the evaluation techniques so that the system could achieve

EPA's goal of having a cost-effective procedure that would yield accurate and reproducible results. The Technical Group agreed that ultimately the BRES must be a tool for managers and decision makers to ensure the long-term integrity of reclaimed sites within the BPSOU. To meet these overall goals, the Technical Group's tasks for the 2001 BRES calibration and validation program were to:

- Select a set of reclaimed sites to test the Draft BRES. These sites included the full range of land types and reclamation conditions present at the BPSOU.
- Verify the efficacy of evaluation parameters in the Draft BRES document and either add or delete parameters.
- Resolve technical, managerial, training and implementation issues through interactive dialog among Technical Group members and build consensus on all issues to the extent possible.
- Ensure that the Final BRES would have a consistent decision logic to make technical recommendations for either repairing problem sites or monitoring potential problem sites.

The general approach to the calibration and validation process was to continue to test and refine the Draft BRES in an iterative manner until the Technical Group was satisfied that the system was ready for use at the BPSOU.

During the calibration and validation field season, the Technical Group visited 13 sites that were representative of the complexity found the BPSOU. Evaluations were performed at these sites as a means to develop and finalize the BRES field form and decision logic for technical recommendations for site corrective action. Specific decision diagrams were created for each of the parameters evaluated in the BRES and a time frame for evaluations and cap repairs was established. At the end of the summer, the Technical Group presented a new draft of the BRES to the Management Group in a series of three meetings and presentations. The Technical Group received suggestions and recommendations for the Management Group and altered parts of the system based on these recommendations; these revisions are included in this final BRES document.

Section 3 Process and Schedule

This section outlines the management of the BRES program and the annual and long-term schedule for the BRES process.

3.1 Management and Administration

Figure 3-1 depicts the BRES management and administration organization structure. The BRES Administrator from the PRP Group will direct the field evaluators and oversee BRES-related data storage issues and maintenance construction. This individual will be advised by and report to the Technical Group, whom will report directly the Management Group. EPA, as the lead agency, and MDEQ, as the support agency, will oversee the BRES program.

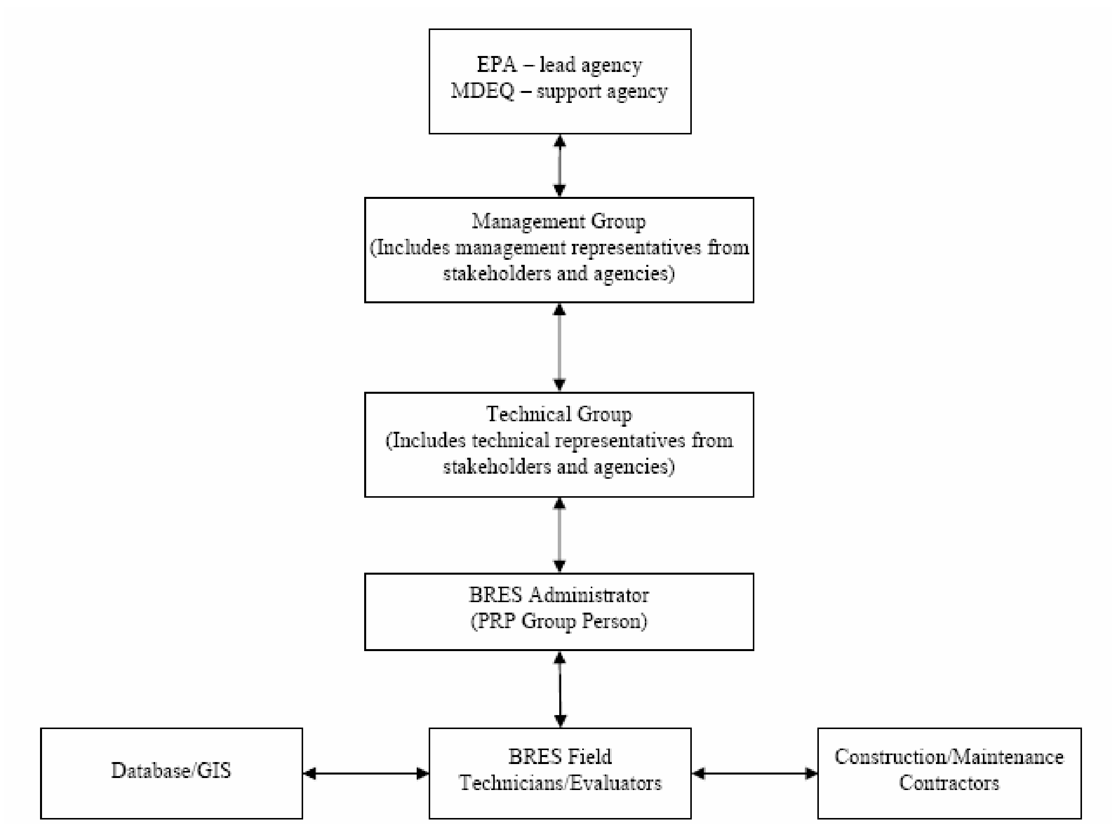

Figure 3-1
BRES Management and Administration

3.2 Timing and Overview

The first year of BRES implementation will follow the ROD. Polygons must be delineated for sites prior to BRES implementation. The summer following polygon delineation will become Year 1 for the BRES process. Annual BRES events are described below. The BRES process will continue indefinitely, unless another program for assessing reclamation is developed by EPA.

3.2.1 Annual Timetable for BRES

The annual BRES process is documented in the Annual BRES Process Flowchart (Appendix E). The BRES Administrator, on behalf of the PRP Group, shall be responsible for meeting reporting deadlines and ensuring that field data are collected, reported, and tracked in the O&M database in a timely manner.

Pre-field assessment preparation should take place in the spring of each year. For the individual sites scheduled for BRES evaluation during the upcoming summer, the administrator should organize reports containing pertinent site information and aerial photographs from the O&M database and GIS. Details about this task are presented below. After pre-field-assessment preparation, the field training session should begin (described below).

Field evaluations will follow the one- to two-week training period. Data may be entered into the BRES database during collection or at the end of the field season. After the field evaluations, the administrator will complete a report of technical recommendations, based on the BRES results and the corresponding BRES decision logic.

The Management Group, which is composed of management representatives of the BPSOU stakeholders, will review the report of technical recommendations and develop a set of management directives, based on recommendations and pertinent modifying criteria. EPA, in consultation with MDEQ, will adopt or modify these recommendations. The final directives will instruct the PRP Group regarding the corrective action work that should be done within the calendar year of the site field evaluations. Based on the final directives, the PRP Group shall develop site-specific O&M corrective action plans. If BRES logic directs further sampling or assessment of sites in order to make a corrective action decision, the PRP Group should notify EPA of sampling or additional assessment activities in time for EPA to review and approve the SAP and provide oversight.

Documentation will be maintained on a site-specific basis. This documentation includes historic data, corrective action reports, and SAPs. Separate files will allow the BRES Administrator and others to track the data, assessment results, and corrective action measures for each site.

The EPA will review and approve the site-specific BRES O&M corrective action plans, with or without modifications, before the spring of the year. Once a plan is approved by EPA, corrective action work may begin. Corrective action work must be completed within a calendar year of the date of the original BRES field evaluation.

3.2.2 Long-Term Schedule

Because of the large number of response action sites in the BPSOU, BRES evaluations will take place in four-year cycles. Preliminary indications are that there may be approximately 150 BPSOU sites where it may be appropriate to use the BRES. At the outset of the remedial design/remedial action (RD/RA) activities at the BPSOU, the initial list of BRES sites will be developed by EPA in consultation with Montana DEQ and other BPSOU stakeholders. Some of these sites may have only a small portion of reclaimed ground because they have been paved or have had a structure built on them. Site review, and reconnaissance if necessary, should be conducted for all sites to determine the appropriateness of using the BRES.

In addition, unreclaimed sites (i.e., Category 2 and 3 sites described in Section 1.3.2) may be addressed by future RD/RA activities if action levels are exceeded or if they are found to be a source of COCs to surface water (via the Surface Water Management Program). These sites will need to be incorporated into the site list for periodic BRES evaluation after capping or removal actions for these sites are completed.

The large number of sites necessitates dividing them into groups and staggering the BRES evaluations and corrective action activities over a four-year period. A four-year cycle was chosen for two reasons:

- The decision logic for the BRES states that after corrective action work is done on a BRES polygon, that polygon should be evaluated with the BRES three full growing seasons after the corrective action work is completed; a four-year cycle provides the correct timing between the corrective action activities and the recurrent BRES evaluations.

- The division of BRES sites into four groups allows adequate time for pre-assessment preparation and field evaluations during the peak standing biomass period of the growing season. A shorter cycle might not allow enough time to perform evaluations on the number of sites to be completed in a year, and a longer cycle would not provide correct timing between BRES evaluations, as articulated in the BRES decision logic.

All sites in the same group will be evaluated during the same year. Groups should not be split once they are created because of the complications that would arise in BRES scheduling and site tracking. The long-term schedule for the BRES is presented in Table 3-1.

	Summer Following ROD	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
BRES Site Evaluations	Polygon delineation	Group A	Group B	Group C	Group D	Group A	Group B	Group C	Group D	
Corrective Action, if necessary			Group A	Group B	Group C	Group D	Group A	Group B	Group C	Group D
Polygon Boundary Re-evaluation										All Groups

Table 3-1
Long-Term BRES Schedule

Polygon delineation will be completed for all sites prior to the first year of the BRES cycle. Once polygons are delineated at sites, they will remain fixed until the official review period in Year 9 of the BRES process. Re-evaluation of polygons in Year 9 allows two full BRES cycles to occur before polygon boundaries are re-evaluated. The logic behind polygon delineation, including the timing of polygon boundary review, is detailed in Section 4.

3.3 Field Crew Training

The BRES Administrator will lead a mandatory one- to two-week field crew training session prior to each field evaluation season. A field manual will be designed and provided to the field crew as a training guide and to assist them with the field evaluation process. Field crew members will also receive software and data management training as needed.

During the training session, field crew members will make quantitative measurements and visual estimates of vegetation and erosional parameters to calibrate themselves to make reproducible estimates of vegetation cover and erosional assessments in the field. Field crew members will also be trained to identify trigger items and correctly record the appropriate information on the field form.

3.3.1 Vegetation

The field crew will be trained to visually estimate vegetation cover on BRES polygons by using a modified point intercept method. The crew will visit several polygons that include a range in percent vegetation cover values. It is recommended that modified point intercept frames of 0.25 square meters (m^2) be used to quantitatively measure cover. The recommended method consists of laser pointers used in conjunction with a grid of 10 points on a frame. The type of material intercepted by the lasers is recorded and used to determine percent live plant cover, litter, rocks, and bare ground. The frames should be placed using a random method that places the frames over an area large enough to represent variability at the site. If the recommended method is not used, EPA requires that an equivalent method be approved by EPA prior to use.

The number of frames necessary to characterize a polygon changes with the variability among frame placements. If the variability is large, more frames are necessary; when the variability is small, fewer frames are needed to adequately characterize the site mean. The following equation (Bonham 1989) may be used to determine sample adequacy for a two-sided confidence interval.

$$n = t^2 s^2 / (K)^2$$

where:

n = number of observations needed to obtain an estimate of the true mean within a defined range (e.g. within 10 percent of the true mean)

t = value selected from t-distribution table

s^2 = the sample variance

K = the proportion that includes the difference of the sample mean from the population mean (e.g. within 10 percent of the true mean). K was set for BRES purposes at 10 percent.

Results of the summer 2001 calibration and validation period (CDM/RRU 2003) indicate that between 30 and 50 frames should be placed at a site, depending on variability within a site (polygon).

After an adequate number of frames are placed and the ground cover measured, the field crew should begin to calibrate themselves to the different percentages of cover. The field crew's experience should be tested by making a visual estimate of cover on an area, then quantitatively measuring cover on the same area. Once the field crew can reliably estimate vegetation cover to within ±10 percent, the vegetation portion of the training is complete.

3.3.2 Erosion

The field crew will be trained in erosion evaluation using a modification of the BLM erosion evaluation method (BLM 1981). The Calibration and Validation Report (CDM/RRU 2003) explains how the BLM method was customized for use in the BRES. After the initial erosional condition training session, field crew members will calibrate themselves by evaluating several sites that vary in erosional condition. The field crew experience will be tested by scoring erosional condition on different BRES polygons using the BRES Erosion Condition Class Determination guidelines, and then comparing their scores with one another. Once the field crew can reliably rank erosional conditions within ±10 percent of the group mean, the erosion evaluation portion of the training will be complete.

3.3.3 Trigger Items

The field crew will be trained to identify trigger items (see Section 3.4.1) and record appropriate information on the field form. The field crew's experience will be tested during the training session by evaluating an area and then comparing evaluations within the group. If there are discrepancies in trigger item identification, the field crew members and the trainer will discuss these discrepancies, referring to the BRES Field Manual when necessary. Training will be complete when the field crew consistently identifies trigger items.

3.4 BRES Field Manual

As previously discussed, a field manual will be developed to outline training activities. The BRES Field Manual will provide instructions for proper completion of BRES field forms. The following topics will be covered in the BRES field manual:

- Preparation of necessary pre-assessment materials
- Instructions for filling out field forms
- Specific instructions on how to visually estimate ground cover and erosional condition
- Definitions and descriptions of trigger items and other pertinent information associated with each trigger item
- Methods of quality control (QC) on field observations

In addition to field evaluation instructions, the BRES Field Manual will include photographs representing different ground cover values for live cover as well as examples of varying degrees of erosional characteristics.

3.5 Field Evaluations

BRES field evaluations will be performed by scientists experienced with the assessment of vegetation and erosional parameters, and who are trained as described above. The BRES was specifically designed for sites where the response action left mine waste in-place. At these sites, vegetated and engineered cap integrity is critical to ensuring waste does not become exposed. Field evaluations will be completed on all sites designated for the BRES in accordance with a four-year cyclical schedule.

3.5.1 Upland Vegetation Caps

An erosive cap is unstable and impermanent. If the cover soil comprising the cap erodes to a point where waste material is exposed, COCs may be transported off-site by water or wind, and may come into contact with human or environmental receptors on the site. The vegetation growing in cover soil overlying waste left-in-place serves several purposes critical to the stability and permanence of the protective cap. First, plants stabilize the soil by minimizing water and/or wind erosion. Second, plant foliage provides a greater surface area than bare ground for rainwater evaporation. Third, plants transpire soil water during carbon assimilation. Both of the latter processes minimize infiltration of surface water to the waste material beneath the cap surface. Standing or fallen dead plant material can reduce wind and water erosion and provide an evaporative surface for rain and storm water; however, excessive plant litter accumulation can retard evaporation and thereby enhance infiltration. In general however, plants and dead plant material act in several ways to minimize surface water percolation and the transport of COCs off-site and to groundwater. Therefore, erosional stability as determined in part by vegetation cover, is critical to a determination of the functionality and permanence of a response action at the BPSOU.

Specific characteristics of a site help identify both localized and polygon-specific cap integrity or stability problems. In the BRES, these characteristics are referred to as trigger items and serve to identify areas of current or imminent cap failures that may cause human health risk because of site conditions. Trigger items of the BRES field evaluation form include:

- Less than 21 percent live cover by desirable species
- Greater than 65 for total erosion evaluation score
- Significant difference between site edges and interiors
- Exposed waste material
- Bulk soil failure, land slumps, or subsidence
- Barren areas
- Gullies

Each of these trigger items is explained in detail in Section 6.

3.5.2 Engineered Cap Evaluation

Engineered caps are constructed using standard engineering materials, as compared to coversoil caps, which are constructed using only cover soil and vegetation. Engineered caps include rip-rap, rock covers, concrete, shotcrete, asphalt, and dirt parking lots or trails. Because engineered caps function as a barrier in areas to which the public has access, it is critical that they remain protective and functional.

A checklist for engineered cap integrity has been developed for use by BRES field evaluators (Appendix F). This checklist will be used during site evaluations when engineered caps are present. Information on this checklist will be entered into the BRES database.

3.5.3 Residential Yards and Playgrounds

The BRES evaluation does not include residential yards or playgrounds. Response actions on these areas are covered in the Butte-Silver Bow County Residential Lead Abatement Program.

3.5.4 Riparian Area Evaluation

The BRES does not include the evaluation of riparian areas; these exist along Silver Bow Creek, and Blacktail Creek within the BPSOU. Only response actions completed in the upland areas of the BPSOU are included in the BRES. If deemed necessary by EPA, a response action decision tool will be developed for these areas. Montana State University's Riparian Evaluation System, which was developed for use on the Clark Fork River, could be modified for use in riparian areas at the BPSOU.

3.6 Annual Maintenance Evaluation

Butte-Silver Bow County personnel currently perform annual maintenance evaluations on BPSOU response action sites. These maintenance evaluations are different from the BRES evaluations. Maintenance evaluations ensure that sites are safe and remain well-maintained by evaluating the following parameters:

- Weeds
- Security
- Debris
- Fire potential
- Adjacent areas
- Signs and fences
- Drainage ditches
- Run-on
- Other

To improve efficiencies, EPA and the PRP Group have discussed conducting maintenance evaluations and the BRES evaluations at the same time for those sites that are scheduled for both. However, until this approach is agreed upon, these evaluations will be conducted separately.

Section 4 Polygon Delineation and Use

Prior to implementation of the four-year BRES cycle, polygon delineation must be completed. This procedure is described in this section.

4.1 Polygons

Because a variety of land units may lie within the same politically bounded site, it would be impossible to assign a meaningful score to the site as a whole. Thus, to improve the precision (or repeatability) of BRES estimates, sites will be divided into smaller land units based upon factors such as vegetation homogeneity, slope angle and aspect, and land type, which might include residential lawns, parking lots, open space, and driveways. These smaller units will reduce within-polygon variability with respect to BRES parameters and thereby increase scoring precision. For example, polygon lines would separate a lawn from a reclaimed grassland area or dirt parking lot. A site that has been reclaimed with rangeland vegetation but has differences in aspect or slope may also be subdivided into polygons because these differences can control site vegetation and erosional characteristics.

Using polygons, the average score within a polygon will describe the actual conditions more precisely than it would if the parameter had a large range. For example, if the vegetation cover in a polygon ranges between 30 and 45 percent, an average reported value of 37.5 percent would describe that stand of vegetation in a way that is useful and interpretable by site managers. Conversely, if the vegetation cover at a site ranges between 10 and 75 percent in different areas, an average value of 42.5 percent does not describe the site in a useful manner.

A larger range in potentially measured values will result in a larger range in the estimated values among observers. If the vegetation cover ranges between 10 and 75 percent at a site, one observer might focus their attention on the parts of the site with less cover while another observer focuses on an area with greater cover. Both observers would have assigned the site vegetation cover a number that they thought was representative. However, these estimates are different because of the wide range of potential conditions to measure. This inconsistency decreases the usefulness of the data for the decision makers. Polygons block the land into more internally homogeneous units and thus increase the repeatability of estimates made for each of the parameters. This increase in repeatability has been observed by researchers working with similar evaluation systems and other statistically based sampling techniques like stratification (BLM 1981); (Hansen 1995); (CDM/RRU 1999); (BLM 2000).

4.1.1 Polygon Delineation Process

Polygon delineation will occur once every nine years. After two full BRES cycles, polygon lines will be re-evaluated and altered if needed. Initial polygon delineation will occur upon completion of the ROD as an Agency-led project with PRP Group interaction. Logistically, polygons will be delineated in two steps. First, aerial photographs will be reviewed in the office to pinpoint specific areas within a site that might differ from each other with respect to land use, erosional characteristics, and/or vegetation cover. Using GIS software, tentative polygon lines will be drawn on the aerial photograph and the preliminary site map will be printed for field use. The preliminary polygon lines are tentative indicators to the field crew about potentially different areas within a site. Aerial photographs are limited because they are a snapshot in time of a dynamic system. Nonetheless, they are an essential preparatory step in polygon delineation. The field crew should also review post-response action information (e.g., as-built drawings) for each site and any other previously collected information. This information/data will support or refute observations in the field and direct the polygon delineation process.

Following the office preparation phase, field crew members will visit each site, bringing with them all preliminary materials. They should walk over the entire area and note differences in land use, vegetation, erosional characteristics, existence of barren areas, and the size of the affected areas. If site conditions differ from aerial photographs, these differences should be noted on the printed aerial photographs. Upon completion of the site reconnaissance, polygon lines will be mapped using a resource-grade GPS with sub-meter accuracy. If necessary, polygon boundary lines will be modified in the GIS program to accurately represent any changes the field crew made to polygon boundaries.

4.1.2 Polygon Delineation Guidelines

1. Vegetation Cover. If vegetation cover varies distinctly across a site, then a polygon boundary shall separate the different areas. Variations in cover may be caused by differences in reclamation techniques, cover soil quality, slope angle, aspect, weed invasion, or plant species. The term distinct in this case is defined by the vegetation cover classes used in the BRES. The cover classes are less than 21 percent, 21-40 percent, and greater than 40 percent live plant cover. Separate polygons should be delineated if the percent vegetation cover between the two areas:

   - differs more than 15 percent, or
   - crosses the threshold between the middle and lower cover classes

   If there is not a sharp line of demarcation between the two different areas, best professional judgment should be used when determining the polygon boundaries.

2. Erosion. If erosional condition varies distinctly across a site, then a polygon boundary should separate the different areas. Differences in erosional condition can be caused by differences in slope or vegetation cover within a site. The term distinct in this case is defined by the erosional condition threshold value of 55 points. Areas should fall into two different polygons if the erosional condition score:

- differs more than 20 points, and
- crosses the threshold score of 55 points

If there is not a sharp line of demarcation between the two different areas, then best professional judgment should be used when determining the polygon boundaries.

3. Barren Areas. Parts of a site with a high frequency of barren areas should be culled out as individual polygons from areas of generally better vegetation. A barren area is defined as an area at least 75 square feet (ft^2), with less than 10 percent total vegetation cover. Rock outcrops do not count as barren areas. If a polygon is delineated because of barren areas, the barren areas should cover at least 25 percent of that polygon. These barren area polygons will allow for representative vegetation cover estimates in both the more barren and better vegetated polygons.

4. Land Form or Land Use. Polygons should be delineated based on differences in landform or land use. For example, engineered caps, ditches (including grass-lined swales), sedimentation ponds, parking lots, gravel trails, playgrounds, asphalt parking lots, and manicured lawns should be separated from each other and from reclaimed open areas by polygon boundaries.

5. Size. Minimum size guidelines for polygon delineation were identified during the calibration and validation period in 2001. Because a predetermined minimum size might interfere with professional judgment during the polygon delineation process, size criteria should be used as a guideline, not a specified requirement. As a guideline, a polygon should generally encompass an area greater than or equal to 10 percent of the site. The size guideline was established to prevent the BRES from incurring an excessive number of polygons.

6. Variable Vegetation Cover or Erosion. Some sites have variable vegetation cover and erosional conditions at small scales, while other sites have large internally homogenous areas that differ from other large areas of the site. When the variation or patchiness occurs at scales that are smaller than 10 percent of the site, or when the entire site is covered by small-scale variability, then the smaller areas of difference should not be broken into separate polygons. Effort should be made by the field crew to obtain the best average vegetation and erosion estimates possible. These variable or patchy polygons provide the most difficult areas to average. Often, repeatability decreases in these patchy polygons. Nonetheless, if the variability occurs at a scale so small that too many polygons would be created at a site, then the best option is to lump all of the small patchy areas into a larger polygon.

4.1.3 Alteration of Polygon Boundaries

Once established, polygon boundaries should only be altered using the mechanisms outlined below. It is anticipated that as system implementation begins, there will be more polygons, but as time passes and polygons are brought up to BRES standards, some polygon boundaries will become irrelevant and will therefore be removed. Some polygon lines will exist for longer periods because they signify a significant break in conditions, such as a steep slope and a flat area. Some polygon lines would remain indefinitely, such as those between a rip-rapped slope and a revegetated grassland area. If new polygons need to be added, they should be delineated as outlined above.

Polygon boundaries will undergo re-evaluation nine years following implementation of the BRES. By year nine, two BRES evaluations will have been completed on all polygons.

During the summer prior to polygon re-assessment, it will be necessary to take a new set of aerial photographs. During re-evaluation, the field crew should follow a process similar to that outlined above. Existing boundaries that appear questionable, based on the aerial photograph will be highlighted. In the field, the survey crew will walk all existing polygon lines and make notes as to whether they are still appropriate or need to be changed. Upon completion of the site reconnaissance, the new polygon lines will be mapped using a GPS with sub-meter accuracy. Polygon boundary lines will be modified in the GIS to accurately represent any changes the field crew made to polygon boundaries.

EPA recognizes that the delineation and re-evaluation of polygons at all sites at one time will be a concentrated effort. Nonetheless, the complete re-evaluation of polygon boundaries in one field season every nine years will have several benefits. First, aerial photographs, taken the year before the re-evaluation, will be current for all sites. Second, a specific field crew can be hired on a seasonal basis once every nine years and trained to perform this task. Third, the evaluation, management, and tracking of polygon boundaries will be easier if done at one time.

4.1.4 Annual Maintenance Evaluation and Polygons

The annual maintenance evaluation (see Section 3.5) will be performed each year on a site-by-site basis; the maintenance evaluation will not be performed for each individual polygon. The site-based approach for the maintenance evaluation was chosen because the questions asked during the maintenance evaluation should not vary within a site. For example, the fences are designed to surround the site based on political boundaries and will not change on a polygon basis within the site.

4.2 Parameters Estimated by Polygon versus by Site

Percent ground cover estimates and erosional condition assessments require a homogenous area for evaluation; therefore, polygons are required for evaluation of these two parameters.

Some parameters can trigger an action and do not require a homogenous area for evaluation; therefore, they are recorded on a site basis and not by individual polygons. These localized trigger items evaluated on a site basis include:

- Significant difference between site edges and interiors
- Exposed waste material
- Bulk soil failure/land slumps/subsidence
- Barren areas
- Gullies

Regardless of the number of polygons, only one BRES field form should be used per site during the field evaluation. In addition to recording the trigger item on the field form, the evaluators should outline and label the area of the trigger item on the aerial photograph. If barren areas are observed on a site, the polygon in which they are located should also be noted on the field evaluation form. Each of the individual trigger items is described in detail in Section 6.

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Section 5 Methods and Procedures

5.1 Office Preparation

Prior to the field season, the BRES Administrator shall prepare field assessment packets for the field crew. The contents of these packets are detailed in the sections below.

5.1.1 Field Forms

The BRES Administrator shall include one field form (Appendix D) for each site in the site assessment packet. To reduce the time spent filling in field forms, field packets will include forms that have been prepared specifically for each site. Static information should be filled in automatically using a mail merge from the Reclamation/O&M database. The following fields should be completed prior to the field visit:

- Site name and number
- Number of polygons
- General slope angle and aspect of site

5.1.2 Aerial Photographs

Field packets will also include aerial photographs prepared specifically for each site. The aerial photograph should be printed on a standard 8.5" x 11" page. The GIS database should be used to add the following information to each aerial photograph:

- Site boundaries
- Polygon boundaries
- Site name and number
- Contour lines (where useful)
- North arrow and scale bar
- Month and year of the aerial photograph
- Site acreage
- Special features such as storm drains, shaft caps, channels, informal sedimentation basins, etc.
- Blank space for day, month, and year of evaluation (to be filled in by evaluator)
- Blank space for evaluator's initials

During the site evaluation, aerial photographs will be used to identify and label the location of trigger items. At the completion of the field evaluation, aerial photographs and field notes should be submitted to the BRES Administrator along with the completed site evaluation field form.

5.1.3 Supplemental Information

Any other data relevant to the evaluation of the site should also be included in the field assessment packet. These data may include dates and details of previous response actions (e.g., cover soil depth and seed mix) and maintenance activities (e.g., weed spraying). Office preparation of field packets should be completed each year during the winter and early spring.

5.2 Field Survey/Site Evaluations

The field survey will occur each summer. Field evaluation of the BRES sites scheduled for evaluation that year should take place between late June and early August, during peak standing biomass. The BRES Administrator will lead the BRES evaluation process. EPA, with assistance from the state, will provide oversight as deemed necessary. Other stakeholders may participate in the BRES process, if they desire.

5.3 Data Transfer and Database Management

Currently, data from the field are being entered and stored in databases managed by ARCO and BSB County; these are ARCO's reclamation database and BSB County's GIS and O&M databases. In the future, new data will be submitted to the BRES Administrator upon completion of fieldwork and then entered into the appropriate database. Database management issues will be refined after completion of the ROD. ARCO is currently developing a data management plan, which will include the BRES.

GIS will be an important component of data management and a GIS file should be created to document the location of trigger items. This polygon layer or shape file should be digitized from notes on the aerial photographs and should track locations of the trigger items and information about them, such as date identified and other information from the field form. A new GIS trigger item layer file should be made at the beginning of every four-year BRES cycle.

A subset of the total data in the BPSOU databases will be exported into GIS format. This information might include, but will not be limited to:

- Soil analytical data
- Vegetation information: species observed, weeds, and percent vegetation cover (method, observer, year)
- Present and past erosion information
- Maintenance activities

- Response action history
- Cover soil depth
- As-built information

5.4 Quality Control Program

A QC program will be instituted to ensure integrity of data used to make management decisions. Two main areas in which data quality will be enforced are vegetation cover and field data transfer.

5.4.1 Vegetation

Visual estimates of plant cover are often preferred in applied contexts for their rapidity. Unfortunately, visual estimates of ground cover are subject to error or potential bias by the person or persons making the estimates. To decrease the range of inter-observer variability in visual estimates, the BRES uses QC protocol.

BRES QC consists of comparing quantitative measurements of ground cover to visual estimates. At the end of each week during the field evaluation season, 10 percent of the polygons evaluated that week will be randomly chosen and then quantitatively measured using the modified point intercept method. If the precision target has not been met, the previous week's site must be reevaluated. Because QC measurements are made weekly, the field crew is continuously able to compare visual estimates with measured values, thus maintaining a level of calibration that allows them to make precise visual cover estimates throughout the field season. Refer to the earlier discussion of the use of the laser point intercept method in Section 3.3.1.

5.4.2 Field, Analytical, and Spatial Data

QC for BRES data is necessary to ensure all data are useful (i.e., accurate) for their intended purpose and properly entered into the databases. Several mechanisms should be used to enforce data quality for the BRES.

Data from the field forms should be verified once they have been entered into the database(s). Optimally, a person other than the person who entered the data would check each entry from the field forms to ensure that the data are correct. If a different person is unavailable, then the original person should enter all data, then check the correctness of all data, in two different steps. This QC step ensures that transcription errors are corrected before data are finalized in the database and disseminated to other users.

When soil or waste materials are analyzed, the quality of the analytical data should be assessed using the validation procedures documented in the Clark Fork River Superfund Site Investigations Data Management and Data Validation Plan (ARCO 2000). Once validation has been performed, data are assigned the following QC codes:

U – Undetected (below the detection limits of the analytical instrument)

E - Enforcement quality data

S - Screening quality data

These QC codes should always be included in the database(s) with the analytical data, so that the quality of the analytical data can always be interpreted by the end user(s).

Spatial data are information associated with a location in space and will be tracked in the GIS database. This information will be input to GIS through either digitization of field notes on aerial photographs or from a GPS survey. Information digitized from aerial photographs will be somewhat imprecise due to the evaluators' limitations with aerial photograph interpretation in the field. Information from a GPS instrument is usually more precise than from a digitized photograph and care should be taken to enforce this precision in several steps. First, GPS-obtained data must be differentially corrected. Second, any points or lines generated with a GPS should be "ground truthed" by projecting the data over an aerial photograph and/or comparing the GPS results of known reference point in the field. If a hand-held GPS unit is being used to mark locations, then the user should ensure that the unit is triangulating from an adequate number of satellites in appropriately distant positions (the number and position of satellites can be checked easily on most units.) The metadata for the GIS files should track how the data were positioned spatially in the system (i.e., GIS or digitized by hand) and the datum to which the points or lines are referenced.

Section 6 Evaluation Parameters

This section defines the BRES field evaluation parameters. For greater detail about how each parameter was selected, please refer to the BRES Calibration and Validation Report (CDM/RRU 2003). A detailed discussion of the decision logic developed by the Technical Group for each parameter is presented in Section 7.

6.1 Ground Cover

Ground cover estimates are used in the BRES as an indicator of the condition of upland vegetation caps. Because ground cover assessments require a homogenous area for evaluation, ground cover is evaluated on a polygon-by-polygon basis, not on an entire site basis. Although several ground cover parameters are estimated at each polygon, percent live vegetation cover is the most critical and is therefore used more extensively in the decision-making process than the other parameters.

6.1.1 Live Cover

Percent live cover refers to the percentage of ground surface covered by the current season's plant growth; exceptions include UWS and noxious weeds, which are defined below. Standing plant material from the current year (i.e., live, dead, or senescent) should be included in the estimate of percent live vegetation cover. During the 2001 calibration and validation period, raw data collected and analyzed indicated that the potential for additive errors in ground cover estimation was less when only live cover estimates were used for site evaluation. Therefore, BRES field personnel should estimate and record all of the vegetation parameters on the field form (Appendix D), but only percent live vegetation cover of desirable species will factor into the decision-making process. The other ground cover values recorded on the field form should be considered if future corrective action is required at the site.

Percent live vegetation cover of desirable species will be used as a trigger item in the BRES. If the evaluation determines that there is less than 21 percent live cover of desirable species, this lack of desirable vegetation triggers a recommendation for additional action at the polygon.

6.1.2 Litter

Litter is defined as the uppermost layer of organic debris composed of dead plant material from previous year's growth or other slightly decomposed organic materials. The BRES definition of litter also includes moss and straw mulch. Litter is recorded on the field form because it might have utility in the decision making process regarding potential corrective action at a site. Litter does not count toward the percent live cover estimate, and is not a trigger item.

6.1.3 Undesirable Weedy Species

UWS are plant species that are acceptable for BPSOU sites in small numbers, but are considered undesirable in large numbers. UWS are identified on the Vegetation

Species Grouping for the BPSOU list (Appendix G). UWS are plants with certain life history characteristics that could undermine the integrity of the response action at the site. For example, the UWS might be shallow rooted, or have a short seasonal, annual or biennial life cycle; characteristics that reduce the stability of a vegetation cap. In the BRES, UWS can only count for up to 5 percent of the total cover on the site. For example, if 10 percent of the site is covered by *Kochia scoparia* and 20 percent is covered by this year's growth of desirable species, then the total live cover estimate would be 25 percent.

6.1.4 Noxious Weeds

Noxious weeds are defined as all plants on the state and county noxious weed lists (Appendix H). Noxious weeds are those regulated by law or those that are difficult to control. In general, noxious weeds are non-native plants that compete with desirable plants for nutrients, water, and/or space. Noxious weeds do not count towards the estimate of percent live vegetation cover, and do not serve as a trigger item. The percent cover by noxious weeds should be estimated in the field and recorded in the BRES database so that appropriate O&M measures can be taken to reduce the weed infestation.

6.1.5 Rocks

During the calibration and validation period, the Technical Group decided that rocks less than 2 inches in size do not contribute to erosion protection, whereas rocks greater than 2 inches may provide some degree of erosion protection. For BRES purposes, therefore, rocks are defined as any solid material greater than 2 inches on at least one side. Material smaller than 2 inches should be considered bare ground when estimating total ground cover. The percent of the polygon covered by rocks should be recorded on the BRES field form and considered when planning corrective action at a site.

6.2 Erosion

The BRES uses a modified version of the BLM Erosion Classification System (BLM 1981). During the calibration and validation process, the Technical Group added greater detail and specificity to the original BLM category descriptions. During BRES site evaluations, the field evaluator should refer to the BRES Erosion Condition Class Determination guideline (Appendix I), and then record scores for each erosion parameter on the BRES field evaluation form. In the BRES, a score of 55 or greater triggers a recommendation for action at a polygon. Because erosional condition assessments require a homogenous area for evaluation, erosion is evaluated on a polygon-by-polygon basis, not across an entire site.

6.3 Site Edges

The edge of a site can be either inside or outside the boundary of a response area. Differences between site edges and the interior of the site are included as a trigger item on the field form and should be evaluated by site, not polygon. Several factors might cause differences between the site interior and the site edge:

- Cover soil may be thin around the site edges, which may cause stressed and sparse vegetation or lack of successful establishment of desirable vegetation due to a lack of adequate rooting depth for desirable plant species.
- Increased erosion at site edges due to run-on from a street, alley, storm water ditch, sidewalk, and/or adjacent property. Site edges may also be steeper than the majority of the site, which may increase erosion due to run-off.
- Unfenced site edges that experience more traffic, especially when there is no adjacent sidewalk. This foot or bike traffic reduces the ability of the vegetation to persist.
- Rock layers around the edges of a site.

Whether a difference between a site edge and the site interior is significant enough to note on the field form will rely, to some degree, on the evaluator's professional judgment. In order to guide the process of site edge difference identification, check box categories are listed on the field form. The purpose of the check boxes will be to guide the evaluator's interpretation of the potential differences in the site edge. Check box parameters are:

- Lime rock barriers
- Increased weeds
- Increased erosion
- Gullies
- Depositional area
- Steeper slope
- Less vegetation
- Other

The items listed above should serve as a guide to be used by BRES field evaluators to identify differences between the edges and interior of a site. If differences are identified at a site and the check boxes on the form have not accounted for these differences, the evaluator should note the differences on the field form. In addition to check boxes, the field form has a space for the evaluator to estimate the width of the affected area. The evaluator should also draw an outline of the affected area on the aerial photo and label it appropriately.

6.4 Exposed Waste Material

Exposed waste material includes mine tailings and waste rock, as well as any soils that have been contaminated by metals, arsenic, or acid material from mining operations in the BPSOU. When the chosen response action is a vegetated soil cap over waste left-in-place, exposed waste material indicates some failure of the cap material to provide adequate cover and an increased potential for human or environmental receptors to come into contact with COCs. The existence of exposed waste material at a site is considered a trigger item; this should be recorded on the BRES field evaluation form and the area outlined and labeled on the aerial photograph.

6.5 Bulk Soil Failure or Mass Instability

Bulk soil movement or mass instability indicates a current or potential for underlying waste material to become exposed. If these situations are identified at a site, the BRES field crew should record this information on the BRES field evaluation form and the area should be outlined and labeled on the aerial photograph. The field form also has a check box for the existence of subsidence at a site, even though subsidence is the responsibility of the landowner and is not a CERCLA issue. Evidence of subsidence will be recorded in the BRES database and BSB County personnel will be notified.

6.6 Barren Areas

Barren coversoil can lead to increased erosion and may compromise cap integrity. Barren areas may be considered BRES trigger items if they are:

- Greater than 75 ft^2 in area
- Have no more than 10 percent total plant cover (live cover + litter) on the area

Barren areas do not include rock outcrops. If the barren area(s) meets the above conditions, the field crew should record the number of barren areas, whether barren areas cover over 25 percent of the site (see Decision Logic – Appendix C), and in which polygon the barren area(s) are located. In addition, the approximate location of the barren area(s) should be outlined and labeled on the aerial photograph. Barren areas are to be included in the erosion evaluation and the estimation of live plant cover for the polygon.

6.7 Gullies

The presence of gullies indicates that soil loss by water erosion is occurring or has occurred in the past, which increases the chance of exposing covered waste material. An active gully has unstable sidewalls with little or no vegetation or recent soil loss by erosion. Active cutting, sometimes referred to as "head-cutting", may be occurring at the up-gradient end of the channel. If a gully is actively eroding it may jeopardize the stability of the vegetation cap and is therefore considered a trigger item.

Conversely, a healing gully is identified by the reestablishment of vegetation on the sidewall and reduction in soil loss in the channel bottom. A healing gully is not considered a trigger item, but the presence of a healing gully and its physical characteristics (depth and length) should be noted on the BRES field form and the location outlined on the aerial photograph. The location of gullies will be tracked in the GIS and O&M databases.

6.8 Field Evaluation - Riparian Lower Area One

EPA conducted an Expedited Response Action for LAO between 1992 and 1997 that included the removal of mill tailings and manganese stockpiles, and the importation of backfill material and revegetation. In addition, a ground water collection and treatment system was constructed as part of the LAO response action. The final configuration for this area will be determined during RD/RA.

The approach to reclamation at LAO differed significantly from that applied to the uplands in Butte. In LAO, waste material was excavated in and around Silver Bow Creek to a specified design contour interval and cover soil was brought in to replace the contaminated soil. The only waste remaining in LAO is located under the slag walls and water treatment plant, or at significant depth (8-10 feet). In contrast, upland BPSOU response action areas have waste left-in-place. For LAO, the concerns are managing and treating contaminated groundwater, maintaining the integrity of the reconstructed stream channel, and preventing potential down cutting of the channel in flood events that may expose deeply buried mine waste material.

The BRES methodology was customized for the uplands and therefore is not applicable to evaluate LAO. A separate O&M plan will be developed by EPA and the PRP Group specifically for LAO to ensure that the response actions function as designed.

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Section 7 Corrective Action Triggers

A decision logic diagram has been developed for each trigger item in the BRES. During the calibration and validation period, Technical and Management Group members agreed upon the logic that should be followed if a BRES evaluation identifies a trigger item at a polygon or site. The decision logic for each parameter follows; decision logic diagrams are included in Appendix C.

7.1 Polygon-Based Parameters

7.1.1 Vegetation

The logic diagram for the vegetation cover category makes distinctions among the three live vegetation cover categories.

1. For polygons that fall in the lowest live vegetation cover category (less than 21 percent), the site must undergo either VI or RI. The VI or RI should be completed on the polygon within a calendar year of the BRES evaluation and the polygon should undergo another BRES evaluation three years following corrective action work (i.e., back on the four-year BRES evaluation cycle). If a site undergoes VI, and then falls into the less than 21 percent live cover category again during any future BRES evaluations, the polygon is then required to undergo RI, in order to meet the BHRS.

2. For polygons that fall into the middle live vegetation cover category (21-40 percent), UWS are considered. If greater than 10 percent of the polygon is covered by UWS, VI will be implemented on the polygon. If less than 10 percent of the area of the polygon is covered by UWS, the polygon should undergo a regularly scheduled BRES evaluation in four years.

3. Polygons that fall into the upper vegetation cover category (41-100 percent) should be re-evaluated in four years.

7.1.2 Erosion

If the erosion evaluation score is 55 or less, no immediate action is required and the polygon will continue on the regular BRES evaluation schedule of every four years. A score of greater than 55 triggers a recommendation for corrective action. An engineering assessment on the erosional and flow patterns shall be performed to determine the appropriate type of corrective action needed to reduce erosion. The approved corrective action plan should be implemented within the calendar year. The area repaired should be monitored at least yearly and preferably also after large storm events. If the erosion control actions are failing, the site should be repaired immediately. The polygon will undergo a full BRES evaluation three years following the corrective action work.

7.2 Localized Trigger Parameters

7.2.1 Site Edges

The site edge parameter is primarily a monitoring category, except when gullies or exposed waste materials are present. Gullies or exposed waste material along the site edge trigger corrective action to repair the gully, and remove or cover the exposed waste material. Corrective action work should be completed within a calendar year of the BRES evaluation and then undergo a full BRES evaluation three years following corrective action work (i.e., back on the four-year BRES evaluation cycle).

If neither gullies nor exposed waste exist, yet a significant difference has been identified between the site edge and the site interior, the area should be tracked in the GIS and O&M databases for future trend analysis to determine whether site edge condition is improving or declining. These sites shall undergo a regularly scheduled BRES evaluation in four years.

7.2.2 Exposed Waste

Exposed waste on a site triggers corrective action. An engineering assessment shall be performed on the area of exposed waste to determine the appropriate type of action needed to repair the cap. The approved corrective action plan must be implemented within the calendar year. The site shall undergo a full BRES evaluation three years following the corrective action work.

7.2.3 Bulk Soil Failure or Mass Instability

Signs of bulk soil failure or land slumps trigger corrective action. An engineering assessment shall be performed on the area to determine the appropriate type of action needed to repair the cap. The approved corrective action plan must be implemented within the calendar year. The area repaired should be monitored after large storm events until the next BRES evaluation, which should be completed three years following the corrective action work. If the corrective actions are failing, the area must be repaired immediately. If subsidence is present on site, then BSB County should be notified so that appropriate actions can be taken.

7.2.4 Barren Areas

If barren area(s) are located within a polygon but cover less than 25 percent of the polygon, a VI plan and/or a RI plan shall be developed to repair only the barren area(s). All pertinent historic data or recent management records should be reviewed prior to plan development. If no usable data or records exist, these data gaps should be filled prior to completion of the corrective action plan. If a VI plan is implemented and the next BRES evaluation indicates that the VI actions failed, the barren areas must be reclaimed in accordance with the BHRS.

If barren area(s) cover over 25 percent or more of a polygon, the same decision logic is used, except that the VI plan and/or RI plan must include the entire polygon, not just the barren areas. If a VI plan is implemented and the next BRES evaluation indicates that the VI actions fail, a RI plan must be developed and approved and the entire polygon must then be reclaimed in accordance with the BHRS.

Under each of the above circumstances, the corrective action must be completed within a calendar year of the BRES evaluation and the polygon should then undergo a full BRES evaluation three years following completion of the corrective action work.

7.2.5 Gullies

If a gully exists within a polygon, it should be noted on the field evaluation form whether the gully is actively eroding or healing. If the gully is healing as defined by the BRES, no immediate action is required and the polygon will continue on the regular BRES evaluation schedule of every four years. If gullies within the polygon are actively eroding, corrective action is recommended. An engineering assessment on the gullies should be performed and an approved corrective action plan to repair the gullies should be implemented within the calendar year. The area repaired should be monitored at least yearly and preferably also after large storm events, until the next BRES evaluation (three years following completion of corrective action work). If the corrective actions are failing, the area should be repaired immediately.

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Section 8 Recommendations and Action

8.1 BRES Technical Report

At the end of each BRES field season, the BRES Administrator shall prepare an annual report summarizing the field season activities, findings, and recommendations for actions in accordance with the requirements of this plan. The BRES Technical Report shall include:

- A summary of each site evaluated
- Date of the evaluation
- Aerial photograph with GIS overlay of trigger items identified
- A brief discussion of the site conditions and trigger items
- Recommendations based on the BRES decision logic

A BRES summary sheet that lists pertinent information shall also be developed for each site. A conclusion section should be included at the end of the report that summarizes the overall findings of the field evaluation season. Table 8-1 below is an example of a summary table.

Total No. of Sites Evaluated	50	**Trigger Items Identified at Each Site (Polygon)**						
Total Polygons	73							
Total Trigger Items	10							
Sites with trigger items:		Vegetation	Erosion	Site Edges	Exposed Waste	Soil Failure	Barren Areas	Gullies
Site # 1, Polygon A	1		1					
Site # 6	1				1			
Site # 7	3	1		1	1			
Site # 14	2	1	1					
Site # 22, Polygon C	3		1				1	1

Table 8-1
Example: Overall Findings from One BRES Evaluation Period

The conclusion section shall also include the schedule for development of the SAP(s) (if collection of analytical data are required), estimated date of data collection, estimated date of annual site corrective action plan(s) completion, and schedule of completion of corrective action work. Relevant information, such as field forms, should be attached to the BRES technical recommendation report.

8.2 Management Review of Technical Report

Upon completion, the BRES technical recommendation report will be reviewed by the Management Group. When reviewing the report for each site/polygon, the Management Group should incorporate any site specific modifying criteria deemed necessary for making decisions that are logical from a management standpoint. For example, a polygon located in a privately owned site has less than 20 percent live vegetation and is used as a parking area. The Technical Group follows the BRES decision logic diagram, and recommends VI or RI at the polygon. The Management Group may decide on a different action after taking into consideration the modifying criteria (in this case land use and property ownership).

8.3 BRES Corrective Action Directives Report

After a complete review of the BRES technical report, the Management Group will make corrective action directives for work. This report should be an EPA lead and should incorporate appropriate Management Group comments and modifications to the technical recommendations report. The BRES corrective action directives report should contain the decisions made by EPA about the corrective action work to be completed at each site/polygon at which trigger items were identified. This includes recommendations for conducting an engineering assessment, more complete vegetation analyses, soil analytical work, and/or the assessment of the need for storm water controls. This document will also be used to guide the PRP Group during development of a SAP for the collection of any environmental data needed to follow the BRES decision logic. These environmental data along with available historical data will be used to produce an annual site-specific corrective action plan.

8.4 Annual Site-Specific Corrective Action Plan

Annual site-specific corrective action plans will be developed each winter by the PRP Group, in accordance with the Directives Report. As mentioned above, several activities must be completed prior to development of this plan for sites that were assessed using the BRES.

- All BRES site evaluations scheduled for that year must be completed and information entered into the database.

- Based on the BRES evaluations, a technical recommendations report should be completed by the BRES Administrator.

- The Management Group should review the technical recommendations report and incorporate relevant modifying criteria into recommendations. A new report will be produced by EPA, which will consider the Management Group's input. This report directs future actions on sites/polygons with trigger items and justifies any deviation from the recommendations made by the Technical Group. This report should be titled BRES Corrective Action Directives Report.

- The PRP Group should review the BRES corrective action directives report and develop a site-specific SAP(s) for collecting additional environmental data relevant to future corrective action work. The SAP(s) must be approved by the EPA prior to sample collection. EPA will have the opportunity to provide sampling oversight, if desired.

- After environmental and historical data have been collected and compiled, the PRP Group will develop site-specific work plans to address the deficiencies identified at specific sites during the BRES evaluation. The work plans will describe the VI or RI work that is proposed to complete the corrective action. These work plans must be reviewed and approved by the EPA. Site-specific work plans will be prepared as addenda to the BRES O&M Plan and will be filed and tracked on a site-by-site basis.

- Following EPA approval, corrective action work may commence on BRES sites/polygons where trigger items were identified. Corrective action work should begin as early in the spring as possible so that all sites/polygons requiring work can be completed during the same field season. This is important because sites/polygons requiring corrective action work will be scheduled for the next BRES evaluation in three years (i.e., on the four-year BRES cycle). The BRES evaluation schedule is strict so that all sites evaluated in the same year will always be evaluated together. For example, if sites A, B, and C are evaluated in 2004, the next time sites A, B, and C will be evaluated is 2008, whether corrective action work is conducted on the site/polygon. Therefore, if corrective action work is not completed on a site/polygon during the calendar year following the BRES evaluation, it will not have three full growing seasons to heal.

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Section 9 Future Activities

Future activities include:

- Finalizing the list of response action sites that will be included in the BRES program
- Determine schedule for taking new low-level aerial photographs
- Polygon delineation
- Completing the BRES Field Manual
- Developing a long-term O&M plan for LAO (if needed)
- Testing the engineered cap integrity checklist and evaluating these caps
- Designing and implementing a data management strategy to ensure accurate and complete tracking of BRES information

Polygon delineation will occur with technical representatives of EPA present. The field team delineating polygons should be skilled in the assessment of vegetation and erosion, especially at reclaimed sites. The field team should use the guidelines provided in this document to decide upon formal boundaries for polygons. Up-to-date aerial photographs should be procured for the polygon delineation process.

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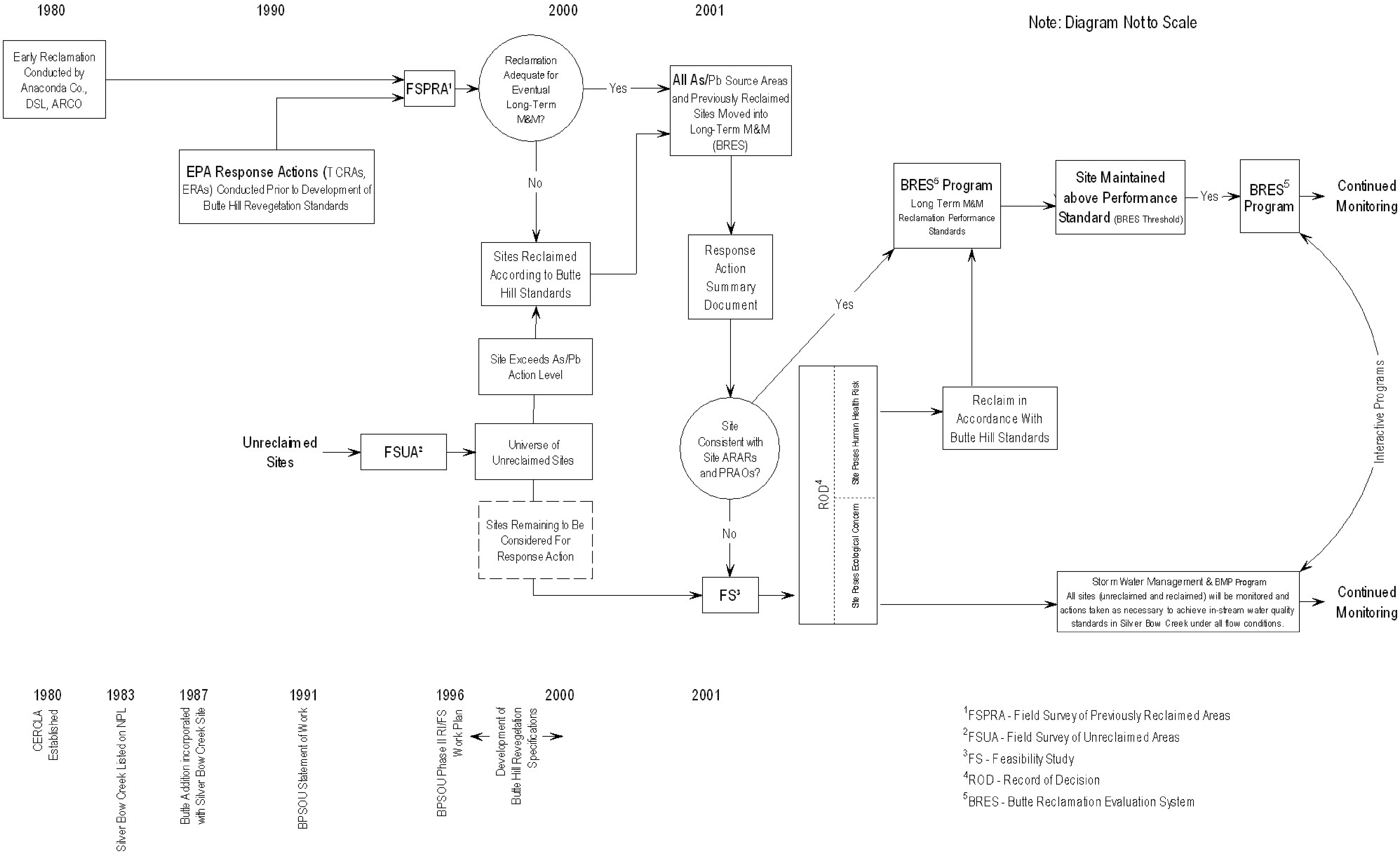
BRES Appendix A

Mine Impacted Land Assessment Logic

Mine-Impacted Land Assessment Logic
Butte Priority Soils Operable Unit



[1]FSPRA - Field Survey of Previously Reclaimed Areas
[2]FSUA - Field Survey of Unreclaimed Areas
[3]FS - Feasibility Study
[4]ROD - Record of Decision
[5]BRES - Butte Reclamation Evaluation System

BRES Appendix B

Butte Hill Revegetation Specifications

BUTTE HILL REVEGETATION SPECIFICATIONS

as of September 2006

BUTTE HILL LIMESTONE STABILIZATION

GENERAL

Work described in this section shall consist of preparing the ground surface for limestone stabilization, hauling, placing, and spreading the limestone and fill on prepared areas in accordance with this Specification at the locations shown on the Drawings.

MATERIALS

Limestone sources will be approved by EPA. Limestone may be from any approved source and shall have a calcium carbonate equivalent content of not less than 65%. All limestone must be <1 inch in diameter and 50% (weight basis) must pass a 60 mesh (<0.25 mm) sieve.

CONSTRUCTION REQUIREMENTS

pH Testing of Subgrade

The responsible party (RP) Group shall test the subgrade soil pH of all areas to be revegetated. The frequency of testing shall not be less than one test per 40,000 square feet (approximately 200 x 200 foot grid). Limestone addition shall include areas to be revegetated where the subgrade soil has a pH of less than 5.5. Acid-base accounting (ABA) may be required by EPA under certain circumstances, such as the presence of acid-generating minerals, and the method used to determine ABA shall be as described in EPA-600/2-78-054. Documentation of this sampling effort, including a map showing sampling locations and sample results, shall be included in the final construction completion document(s) for the project.

Installation of Limestone

The surface of the subgrade in the area to be covered shall be brought to grade and finished smooth and uniform immediately prior to dumping and spreading the limestone. The limestone shall be placed prior to the placing of the cover soil. A minimum 350 tons/acre (approximately 2 inches) of limestone shall be placed on the low pH soil. Placement of the limestone layer on a site will be based on site-specific data and approved by EPA prior to placement of limestone.

Grades on the area to be covered shall be maintained in a true and even condition. Where grades have not been established, the areas shall be graded and sloped to drain. The surface shall be left smooth in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

BUTTE HILL COVER SOIL

GENERAL

The work of this section covers all operations required for furnishing, excavating, hauling, stockpiling, spreading, and seedbed preparation of approved cover soil.

SUBMITTALS

Cover soil submittals will be provided in the Design Report or under separate cover and approved by EPA prior to use. The following submittals shall be provided to EPA for each cover soil source:

- The intended cover soil source site location, including details on the area and depth to be excavated at the source site location.

- For each cover soil source, the RP Group shall be required to secure at least 3 soil samples from the source area. EPA will be notified in advance of the sampling effort and the approximate location and depth where samples will be collected.

- Each of the above 3 soil samples shall be analyzed by an approved laboratory for the following parameters: texture class and particle size; pH; saturation percent; electrical conductivity (EC) in mmhos/cm; organic matter percent; NO_3 - nitrogen; available phosphorus (P); and available potassium (K). The above parameters shall be analyzed using USDA classification and test methods as described in ASA/SSSA Monograph No. 9, Methods of Soil Analysis, Parts 1-2, most recent edition or as described in EPA approved Clark Fork River Superfund Site Investigations documents. Also, each of the above 3 soil samples shall be analyzed by an approved laboratory for the following soil metals parameters: arsenic, cadmium, copper, lead, and zinc. Cover soil placement shall not begin until test results of the soil samples are known.

MATERIALS

Cover soil sources will be approved by EPA. Cover soil thickness shall be a minimum of 18 inches, unless otherwise approved by EPA in writing. Eighteen inches is considered the minimum thickness required for long-term vegetation success. Sufficient cover soil should be applied to account for settling, sloughing, and erosion. Cover soil material shall be reasonably free of any trash, rocks, lumps of soil, stumps, and brush. Rock content (i.e., particles >2.0 mm) must constitute <45% (by volume) of the cover soil and the maximum allowable rock size is 6 inches in diameter. To the extent possible, the cover soil source should be free of any noxious weeds.

Cover soil shall be a friable material and the <2.0 mm fraction characterized as loam, sandy loam, sandy clay loam, sandy clay, clay loam, silty clay, silty clay loam, silt loam, or silt in accordance with the USDA Soil Conservation Service textural classification provided below. Per approval of EPA, loamy sand may be acceptable from 6 to 18 inches in certain circumstances.

The soil pH shall be between 5.5 and 8.5. The soil SAR shall be <12. Soil saturation percent will be less than 85% and greater than 25%. The soil shall have an EC less than 4 mmhos/cm. NO_3, P, and K will be used by EPA and the RP Group to verify fertilizer rates.

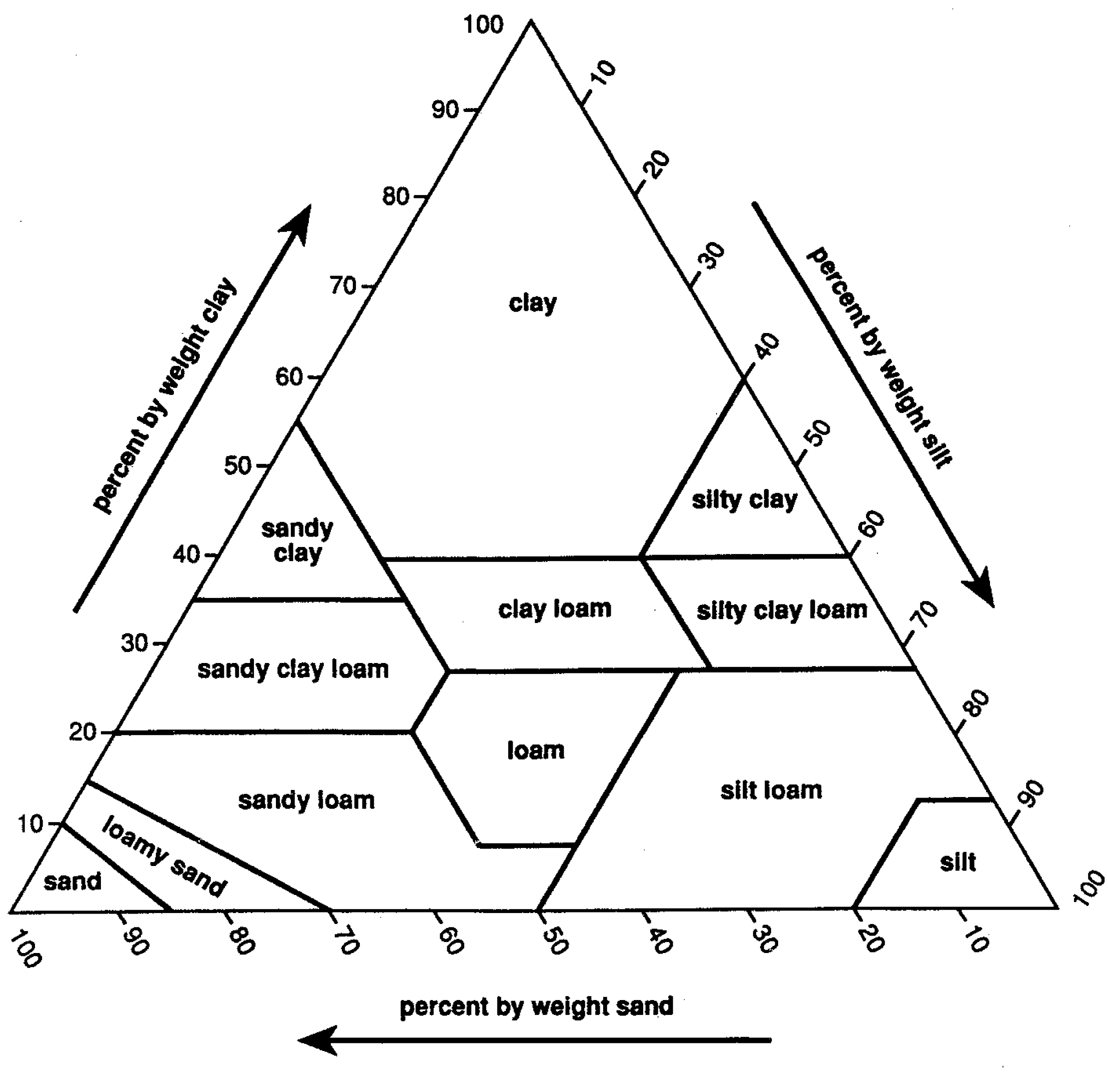


Figure 1. Graphic guide for textural classification of the less than 2 mm portion. (Source: USDA Soil Conservation Service)

The following chemical suitability criteria are general guidelines to be followed as screening standards:

As	<97 mg/kg
Cd	<4 mg/kg
Cu	<250 mg/kg
Pb	<100 mg/kg
Zn	<250 mg/kg

With the exception of zinc, these suitability criteria were established for parks, play areas, and residential yards in the Final Work Plan for Residential Areas, Butte Priority Soils Expedited Response Action prepared by ARCO dated May 1, 1995. These values were provided in a February 14, 1995, letter from Sara Weinstock (EPA) to Dave Sinkbeil (ARCO) providing final comments on the above work plan. The criterion for zinc was reduced to <250 mg/kg from <500 mg/kg to take into account potential phytotoxic effects noted at the higher level in the Final Baseline Ecological Risk Assessment, Anaconda Regional Water, Waste, and Soils Operable Unit, Anaconda Smelter NPL Site, Anaconda, Montana, prepared in October 1997 by CDM Federal Programs Corporation for EPA. The chemical suitability criteria listed above were established for the Butte Hill and may not be appropriate for use at other Clark Fork River Basin Superfund Sites.

It should be noted that some exceedances of the above criteria may still allow successful long-term vegetation. Therefore, if cover soil sampling shows a variance from the chemical suitability criteria, the RP Group will notify EPA and a plan to address the usability of that cover soil source will be discussed. EPA must approve in writing any cover soil sources which exceed the above suitability criteria.

CONSTRUCTION REQUIREMENTS

Visual inspection of excavated cover soil shall be a continuous process to carefully observe and recognize changes in source material characteristics. Visual inspection, in conjunction with hand-texturing of the <2.0 mm fraction, will be used to determine the adequacy of the borrow material ahead of excavation, to assure that current material meets textural criteria, and to identify areas to move to if material begins to fall out of specification. Each inspection shall record the location, test number for that day, date, time, estimated rock content percentage, and soil texture (<2.0 mm fraction). The frequency of inspection is dependent on the variability of the cover soil source material, but must be performed and recorded at least once daily during periods of source material excavation and transport. It is desirable to have the same person perform the inspections for the duration of excavation at a particular source area. In addition to the above visual inspections, textural analysis by laboratory hydrometer testing may be requested by EPA at a rate not to exceed one test for every 5,000 cubic yards of cover soil material excavated. These tests will be used for comparison and guidance for field testing and field observations. Copies of all inspection records and laboratory analyses shall be provided to EPA for review. Summaries of inspection records and analyses shall be included in the final construction completion documents for the project.

For revegetation purposes, slopes must not exceed a maximum of 3:1 (3 horizontal to 1 vertical) unless previously agreed to by EPA and the RP Group because of site specific requirements. Cover soil shall not be placed until the areas to be covered have been properly prepared, the limestone layer appropriately applied (if required), all construction work in the area has been completed and approved by the RP Group, and EPA notified that all subgrade preparations have been completed.

After the cover soil has been spread, large clods, hard lumps, rocks, and large roots over 6 inches in diameter; litter; or other foreign material (exposed iron, timbers, etc.) shall be raked up, removed from the cover soil and disposed of properly. Further preparation of the cover soil for seeding is provided in the specifications for Seeding and Fertilizing.

The RP Group shall grade the source area borrow site(s) to existing contours at slopes not to exceed 3:1 (unless previously agreed to by EPA and the RP Group because of site specific requirements) and to provide positive drainage. The RP Group shall replace stockpiled topsoil to the borrow area. The borrow area shall be prepared for seeding, mulching, and fertilizing as are other areas receiving cover soil.

BUTTE HILL ORGANIC AMENDMENT APPLICATION

GENERAL

Organic amendment application shall consist of furnishing, applying, and incorporating soil amendments, such as manure and compost, at locations and rates designated on the Drawings.

SUBMITTALS

Organic amendment submittals will be provided in the Design Report or under separate cover and approved by EPA prior to use. The following submittals shall be provided to EPA for each organic amendment source:

- Location of Supplier;
- For each supplier, at least three organic amendment analyses, including gravimetric water content, rock and other fragment content, and organic matter content, as described further under Materials; and
- Proposed organic amendment application and incorporation methods and equipment.

MATERIALS

Analyses for organic amendments (such as manure, compost, etc.) shall include the gravimetric water content (%, dry weight), the percentage of rock and/or other fragments >2.0 mm fraction (%, dry weight), and organic matter content of the <2.0 mm fraction (%, dry weight). The organic matter content of the <2.0 mm fraction shall be determined in the laboratory using Walkley-Black procedure, ASA, Meth. Soil Anal., 1986, Method 29-3.5.2.

If manure is used as the organic amendment source, cattle manure shall be the preferred manure type. Straw bedding material mixed into the manure is acceptable, but it shall not constitute more than 20% of the dry weight.

Application Rate

The field application rate shall be calculated using 3% organic amendment on a dry weight basis in the upper 6 inches of cover soil. Upon approval or direction from EPA, the 3% application rate may be modified to account for site-specific conditions. Analyses for organic amendments shall be submitted for each Supplier on a regular basis to determine if adjustments to the field application rates are necessary. The water and rock and/or other fragment content shall be deducted in calculating the field organic amendment application rate. Documentation of the organic amendment application, including application rate calculations, shall be included in the final construction completion documents(s) for the project.

CONSTRUCTION REQUIREMENTS

Stockpiling Organic Amendment

Prior to stockpiling organic amendment on site, the Contractor shall develop an acceptable stockpiling plan for the RP Group review and approval. The plan shall include the location of the stockpile and adequate measures to prevent contamination of underlying and adjacent soils and prevent air or water pollution.

Site Grading

Prior to placement of the organic amendment, all areas shall be graded as necessary to approximately restore the design contours of the ground or to produce a contour that will blend with contours of adjacent areas. This shall include grading erosion channels in revegetated areas that are to receive organic amendment.

Organic Amendment Application

Organic Amendment shall be applied with agricultural manure spreaders or other approved application equipment that enables spreading a uniformly regulated amount of material.

For a specified application rate, the Contractor shall apply the organic amendment in a uniform manner across the landscape. Localized organic amendment application thicker than 6 inches is unacceptable.

Contractor shall calibrate the organic amendment spreader prior to each use of the equipment unless site conditions have not changed and equipment settings have not been altered since previous calibration. Calibration records shall be furnished to the RP Group. Upon request, copies of equipment calibration shall be provided to EPA for review. All calibration records shall be included in the final construction completion document(s) for the project.

Under no circumstances shall the Contractor apply the organic amendment during wind conditions strong enough to displace material onto adjacent sites.

Organic Amendment Incorporation

Following organic amendment application, the soil shall be ripped to a 6-inch depth at 12-inch centers. The soil shall then be tilled to a depth of 6 inches with a disc, rototiller, moldboard plow, or chisel plow. An agricultural disc with a disc diameter of approximately 20 inches having cone-shaped discs at a spacing width of 6-8 inches is recommended. Multiple tilling equipment passes may be required to achieve adequate incorporation. Adequate incorporation will be a complete and uniform mixing of the manure and soil to a depth of 6 inches. All tillage procedures shall be completed as soon as practicable after amendment application.

BUTTE HILL SEEDING AND FERTILIZING

GENERAL

Revegetation work described in this section includes fertilization, seeding, and mulching on all project designated and disturbed areas upon completion of construction work. These areas include finished embankment slopes, borrow areas, areas to be revegetated, and disturbed areas.

MATERIALS

Seed

Seed mixes used must be in compliance with all applicable laws and regulations, including Section 80-5-123, MCA, (Label requirements for agricultural, vegetable, flower and indigenous seeds), 80-5-134, MCA, (Prohibitions), and other state and county restrictions and requirements relating to seed mixes and labeling. Weed species prohibited in the mix should include those species prohibited in the downstream Montana counties as well as those prohibited in the county of planting.

Hand collected native species and some of the special wetland species collected cannot meet the following requirements. All other seed shall comply with, and be labeled in accordance with Montana seed law, Title 80, Chapter 5, Montana Code Annotated (MCA). Indigenous seeds, as defined in Section 80-5-120(14), MCA, in amounts of one pound or more, whether in packages or bulk, must be labeled with the following information:

1. Name and mailing address of the seed labeler;

2. Lot number or other lot identification mark;

3. The Statement "Labeled only for reclamation purposes";

4. The common name, genus, species, and subspecies, when applicable, including the name of each kind of seed present in excess of 5 percent. When two or more kinds of seed are named on the label, the label shall specify the percentage of each. When only one kind of seed is present in excess of 5 percent and no variety name or type designation is shown, the percentage must apply to seed of the kind named. If the name of the variety is given, the name may be associated with the name of the kind. The percentage in this case may be shown as "pure seed" and must apply only to the seed of the variety named;

5. State or county of origin;

6. The percentage of viable seed, together with the date of the test. When labeling mixtures, the percentage viability of each kind shall be stated. The method used to determine viability shall be stated on the label;

7. The percentage by weight of pure seed;

8. The percentage by weight of all seeds;

9. The percentage by weight of inert matter;

10. The percentage by weight of other crop seeds; and

11. The name and rate of occurrence per pound of each kind of restricted weed seed present;

As required by ARM 4.12.3010, seed shall contain no "Prohibited" noxious weed seed. The seed shall contain no "Restricted" weed seed in excess of the maximum numbers per pound, as specified by ARM 4.12.3011, or as specified by the appropriate BSB County Weed Board, whichever is more stringent.

As defined by MCA 80-5-120(14), indigenous seeds include the seeds of those plants that are naturally adapted to an area where the intended use is for revegetation of disturbed sites. These species include grasses, forbs, shrubs, and legumes.

The Contractor must supply the RP Group with all seed bag tags and certification from the supplier stating that the seed complies with the Federal Seed Act and the Montana Seed Laws, Title 80, Chapter 5, MCA and applicable regulations. Upon request, copies of said tags shall be submitted to EPA for review. Copies of seed bag tags and certification shall be included in the final construction completion documentation the project.

When legumes are seeded as the predominant mixture, the seed supplier shall include inoculants (rhizobia) and provide documentation as specified in the Seed Certification. Seed Certifications shall be submitted to the RP Group prior to any seeding. The Contractor shall also submit a copy of the bill or other documentation from the seed supplier showing actual bulk weights of the individual seed types combined in the mix an verification of legume inoculation. The required certifications and documentation shall be provided to the RP Group at least three days prior to the seeding.

Fertilizer

Fertilizer shall be delivered in standard-size bags of the manufacturer showing weight analysis and manufacturer’s name, or in bulk quantities accompanied with written certifications from the manufacturer stating that the fertilizer supplied complies with applicable Specifications.

Fertilizer shall be soluble commercial carrier of available plant food element or combination thereof. The fertilizer to be used on the project shall supply the quantities of available chemical elements stipulated below. The fertilizer shall be of uniform composition and in good condition for application by suitable equipment. It shall be labeled with the manufacturer’s guaranteed analysis, as governed by applicable fertilizer laws. Any fertilizer that becomes contaminated or damaged, making it unsuitable for use, shall not be accepted. All required fertilizer certificates shall be provided to the RP Group a minimum of three days prior to fertilizing. The certification shall include the guaranteed analysis of the fertilizers stated in the terms of the percentages of nitrogen, and available phosphorous, potash, and boron, in that order.

Mulch

Vegetative mulch shall be either grass hay or straw. Grass hay material shall be composed primarily of perennial grasses. The grass hay mulch shall contain greater than 70 percent grass by weight and shall not contain more than 10 percent alfalfa, crested wheatgrass or yellow sweet clover. Grass hay shall be relatively free of noxious weeds and other undesirable species.

Straw mulch material shall be clean grain straw, shall be relatively free of noxious weeds and other undesirable species, and shall not contain greater than 5 percent cereal seed by weight, i.e., seed heads. Wheat straw will be used whenever possible. Harvesting will be performed with modern combines, which leave less grain in the straw. Written approval of straw and hay sources from the supervisor of the BSB County weed board shall be obtained.

Chopped or ground material is not acceptable. The mulch material is not acceptable if it is damaged by rotting, molding, etc. to seriously limit its use for mulch. It shall be relatively free of stones, dirt, roots, stumps, or other foreign material.

Application rates shall be 3,000 lbs/acre on flat non-critical erosion and potential dust generating areas and 4,000 lbs/acre on all critical runoff and potential dust generating areas. Exact application rates will be adjusted in the field to accommodate differences in mulch material and seedbed conditions.

CONSTRUCTION REQUIREMENTS

Seedbed Preparation

Prior to executing the seeding, fertilizing and mulching work items, the seed bed at all sites shall be prepared so these items can most efficiently be completed, with the areas resulting in reasonable conformity to specified line and grade. The fertilizing, seeding, and mulching work items shall be executed only after the seedbed condition has been approved by the RP Group. The cover soil shall be prepared as described in the Cover Soil specifications.

The seedbed surface must be in a condition that does not preclude growth at the time of application of seed. Conditions that may preclude growth include, but are not limited to: large clumps, clods, and impervious crusts of dirt; areas too tightly compacted to allow seed growth; and areas of loose soils which could possibly become too compacted during the seed applications to allow growth. The decisions on the conditions of the seedbed shall be made by the RP Group. If the RP Group determines the seedbed is inadequate for seeding, the Contractor shall treat the inadequate areas, as directed by the RP Group, to attain as nearly as practicable the adequate condition at no additional cost to the RP Group.

Excessively tight or compacted soils shall be loosened to the minimum depth of 6 inches. Disking, chiseling, or tilling of the soils shall be done at right angles to the natural flow of water on the slopes, unless otherwise directed or approved by the RP Group. Compaction of the soil, when required, shall be performed by equipment that shall produce a uniform rough-textured surface ready for seeding and mulching.

Existing structures and facilities shall be adequately protected and any damage done by the Contractor shall be repaired or adjusted to the satisfaction of the RP Group.

Seed Application

General

Slopes and areas finished during the period of October 15 through June 15 may be permanently seeded within this time period. The Contractor must obtain the RP Group permission to commence seeding operations. Slopes and areas finished during the period June 16 through October 14 shall receive an annual cover crop from the strawmulch seed to protect the in-place cover soils during this period. The control of noxious weeds and other undesirable species will also be addressed during this period. The perennial seed mix shall then be applied to the areas after October 15. EPA shall be notified prior to commencement of seeding activities.

Specifications of each type of seed mix are outlined below. The seeding of steep slopes, narrow medians, or small areas that are impractical to seed by drill may be performed by using the hydraulic seeding methods, when approved by the RP Group. The hydraulic seeding methods shall be used when the seedbed surface is too wet or swampy to permit seeding by drill. Hydraulic seeding methods shall not be used during adverse weather, as determined by the RP Group.

The applied seed, regardless of the method of application, shall not be covered by a soil thickness greater than 1 inch in depth.

Seed Application Equipment

Drill Seeding

Seeding equipment used for applying grass/forb seed must be designed, modified or equipped to regulate the application rate and planting depth of the seed mixture. Seed must be uniformly distributed in the drill hopper during the drilling operation. Acceptable drills are: custom seeders, furrow drills, disc drills or other drills approved by the RP Group. All seeding equipment shall be operated perpendicular to the slope. Contractor shall calibrate the drill seeder prior to each use of the equipment unless site conditions have not changed and equipment settings have not been altered since previous calibration. Calibration records shall be furnished to the RP Group. Upon request, copies of equipment calibration shall be provided to EPA for review. A summary of all calibration records shall be included in the final construction completion document(s) for the project.

Planting depth shall be regulated by depth bands or coulters. The drill box shall be partitioned by dividers no more than 24 inches apart, in order to provide for more even distribution on sloping areas. The rows or planted seed shall be a maximum of 8 inches apart. Drilling depth shall be from 1/4 to 1 inch.

Broadcast Seeding

Seeding by hand or mechanical broadcasting shall be permitted on areas inaccessible to drills or impractical to seed by other prescribed methods. The broadcast seeding rate shall not be less than twice the drill seeding rate. Following the seeding, the soil shall be hand-raked to cover the seed. Broadcast seeding requires the prior approval of the RP Group.

Hydraulic Seeding

The Contractor must provide one pound of wood fiber mulch per each 3 gallons water in the hydraulic seeder as a cushion against seed damage. The mulch used as a cushion may be part of the total required mulch with the remainder applied after the seed is in place. The Contractor may be required to use extension hoses to reach the extremities of slopes.

When using vegetative mulch, the Contractor may mix the seed with the fertilizer if his hydraulic seed equipment is capable of uniformly mixing water, fertilizer, and seed, in that order, and power blowing or spraying the mixture uniformly over the seedbed. After blending, the slurry shall be applied to the seedbed within 45 minutes after the seed has been added to the water-fertilizer mixture. If the slurry cannot be applied within the specified time, it shall be fortified, at no cost to the RP Group, with the correct ratio of seed to the remaining slurry and a new 45-minute time frame established for applying the fortified mixture. At no time shall seed and fertilizer remain in a slurry for more than 45 minutes.

<u>Seed Application Areas/Rates</u> - The revegetation mixes include:

Butte Hill 1997 Primary Seed Mixture
Revegetation Mix

Seed Mixture	Rate, #PLS/Acre
Slender Wheatgrass	3.0
Thickspike Wheatgrass	2.0
Sheep Fescue	2.0
Crested Wheatgrass	1.0
Ladak Alfalfa	1.0
Red Clover	2.0
Canada Bluegrass	1.0
Birdsfoot Trefoil	1.0
Total	**13.0**

Butte Hill

Alternate Seed Mixture No. 1 - Gentle Sloped Areas (Less than 10:1) Revegetation Mix

Seed Mixture	Rate, #PLS/Acre	Planting
Bozoisky Russian Wildrye	5.0	Initial seeding, drill seeded on 15-18 inch centers.
Ladak Alfalfa	2.0	Interseeded during following years as determined by vegetation monitoring.
Total	**7.0**	

Butte Hill

Alternate Seed Mixture No. 2 B Grass-lined Ditches

Seed Mixture	Rate, #PLS/Acre
Smooth Brome	5.0
Birdsfoot Trefoil	1.0
Red Clover	0.5

Pure live seed application rates shall be as specified in the tables.

The 1997 primary seed mixture was proposed by BSB County and is based upon their monitoring results for successful revegetation within the Butte area and has been reviewed and approved by BSB County, EPA and the State for use in upland areas of the Butte Priority Soils Operable Unit. The Alternate Seed Mixture No. 1 will only be used in areas with slopes of <10:1 that are particularly susceptible to weed infestation. Additional optimal conditions for use of the alternative seed mix include locations with high moisture holding capacity and shelter from strong wind conditions. The Alternate Seed Mixture No. 2 has been proposed by BSB County and is an option for hand seeding grass-lined ditches and detention basins.

Calculations of pure “live seed” may be made on the basis of either a germination test or a tetrazolium test in addition to the purity analysis. Seed shall be applied on a pure “live seed” basis. The quantity of pure “live seed” in a 100-lb. container shall be determined by the formula: 100 multiplied by germination percentage, and this product multiplied by the purity percentage. For example, if the seed is 85 percent pure and test 90 percent germination, then a 100-lb. container would contain 76.5 pounds of pure “live seed”.

Fertilizer Application

If surface soil nutrient availability data are not available, fertilizer will be applied at a rate to achieve soil concentrations of 60 lbs. of nitrogen (N) per acre, 80 lbs. of P_2O_5 per acre, and 150 lbs. of K_2O per acre. Mechanical or hydraulic methods of application are allowed, providing a uniform application at the specified rate is accomplished. The application method is subject to approval by the RP Group. When scheduling and soil conditions permit, the fertilizer shall be incorporated into the soil by disking, raking, or shallow plowing to the full depth of the topsoil or to a maximum depth of six inches, whichever is less.

Fertilizer shall be applied to the prepared seedbed prior to seeding or mulching and shall be blended with the top layer of soil or concurrently with the seed (as "no-till" drills allow). Upon EPA approval, fertilizer may be applied subsequent to seeding and mulching. Re-fertilization following seedling establishment will not require incorporation. In no instance shall subsoil be incorporated into the seedbed as a result of the fertilization operation.

Mulch Application

Mulch is usually applied during the summer and early fall and drill seeded after October 15^{th}. The mulch shall be applied in a uniform manner by a mulch spreader at rates varying from 2,000 to 4,000 lbs. per acre. The actual rate utilized shall depend upon site conditions (i.e., slope, erosion potential, etc.) and shall be approved by the RP Group and EPA prior to application. The mulch spreader shall be designed specifically for this type of work. The vegetative material shall be fed in the mechanical spreader at an even, uniform rate.

The mulch shall be anchored into the seedbed by using a mulch tiller (crimper). Straw or hay shall be clean grain straw and shall be pliable.

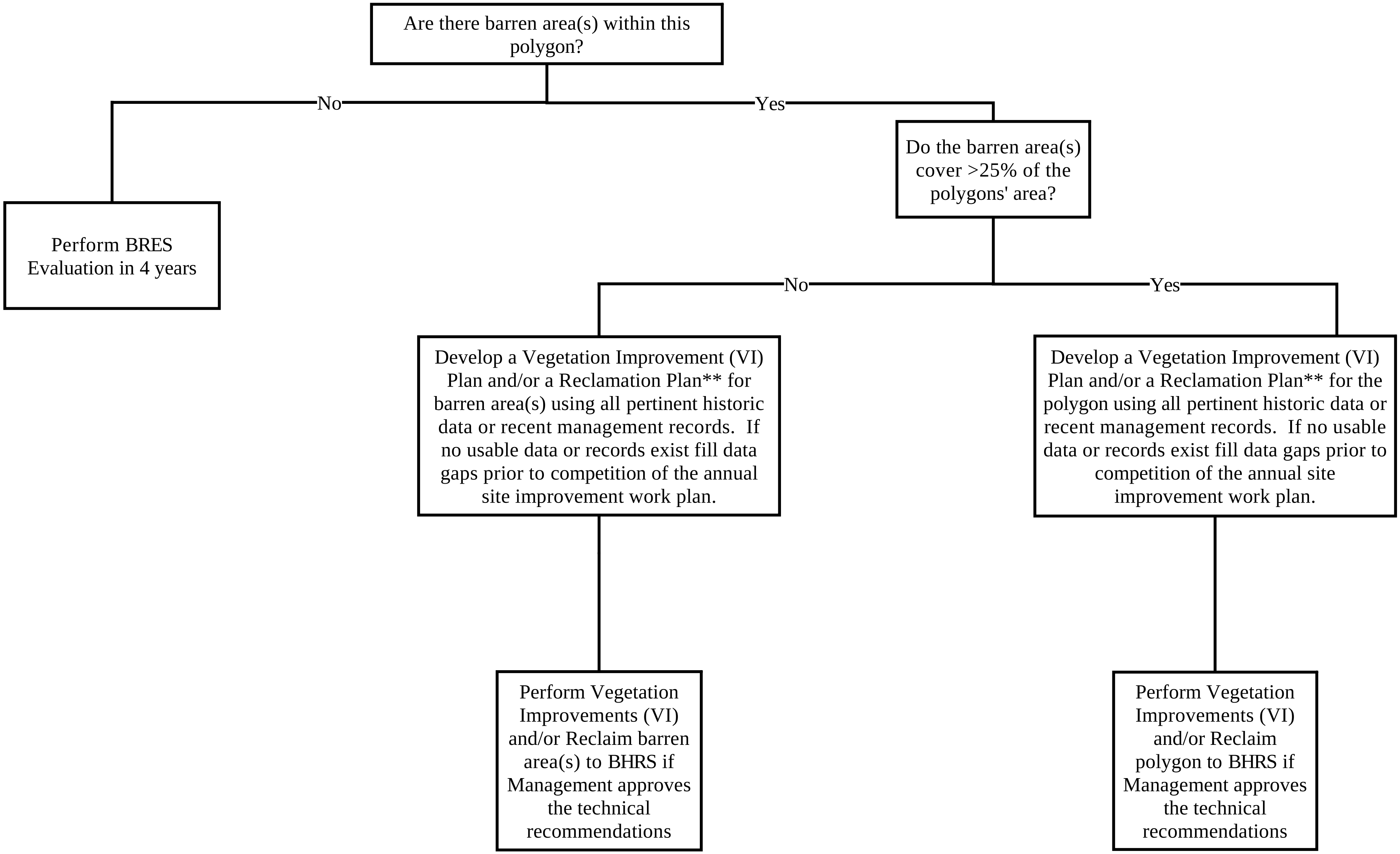
Mulch tillers shall have round, flat, notched blades of these approximate dimensions: 0.25-inch thick by 18 inches in diameter and spaced 8 inches apart. The tiller shall have sufficient weight to force the vegetative mulch a minimum of 3 inches into the soil and shall be equipped with disc scrapers. Mulch tilling shall be done on all slopes capable of being safely traversed by a tracked vehicle. All mulch tilling shall be done perpendicular of the flow-line of the slope.

Mulch, where required, will be applied to seeded areas as close as possible to the completion of seeding operations for the area. Mulch shall not be applied in the presence of free surface water, but may be applied upon damp ground.

Mulch shall not be applied to areas having a substantial vegetative growth, such as grasses, weeds, and grains. Areas not to be mulched shall be determined by the RP Group. Mulching shall not be done during adverse weather conditions or when wind prevents uniform distribution. Application shall be in a manner to not seriously disturb the seedbed surface.

BRES Appendix C

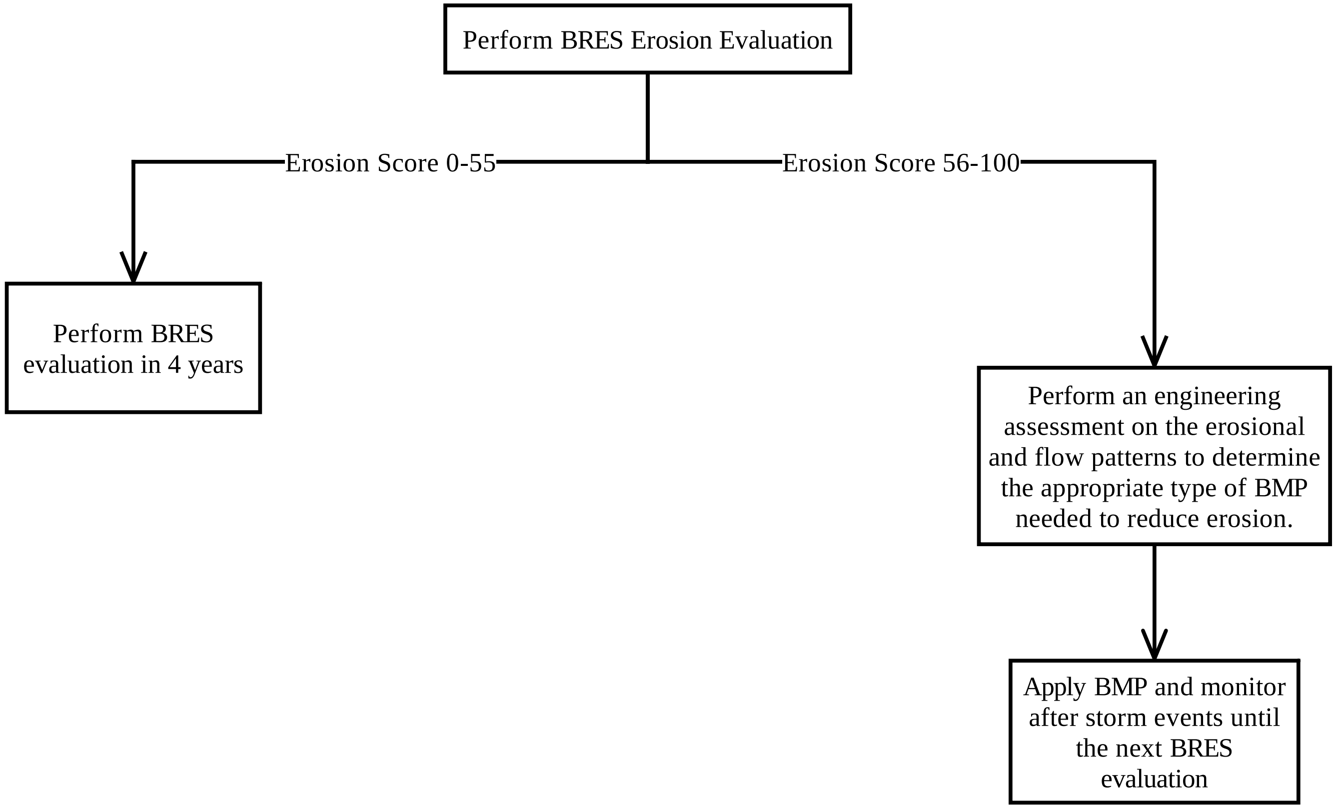
BRES Decision Logic



**Reclamation will occur only within a polygon that has had Vegetation Improvements (VI) fail and is not meeting the BHRS.

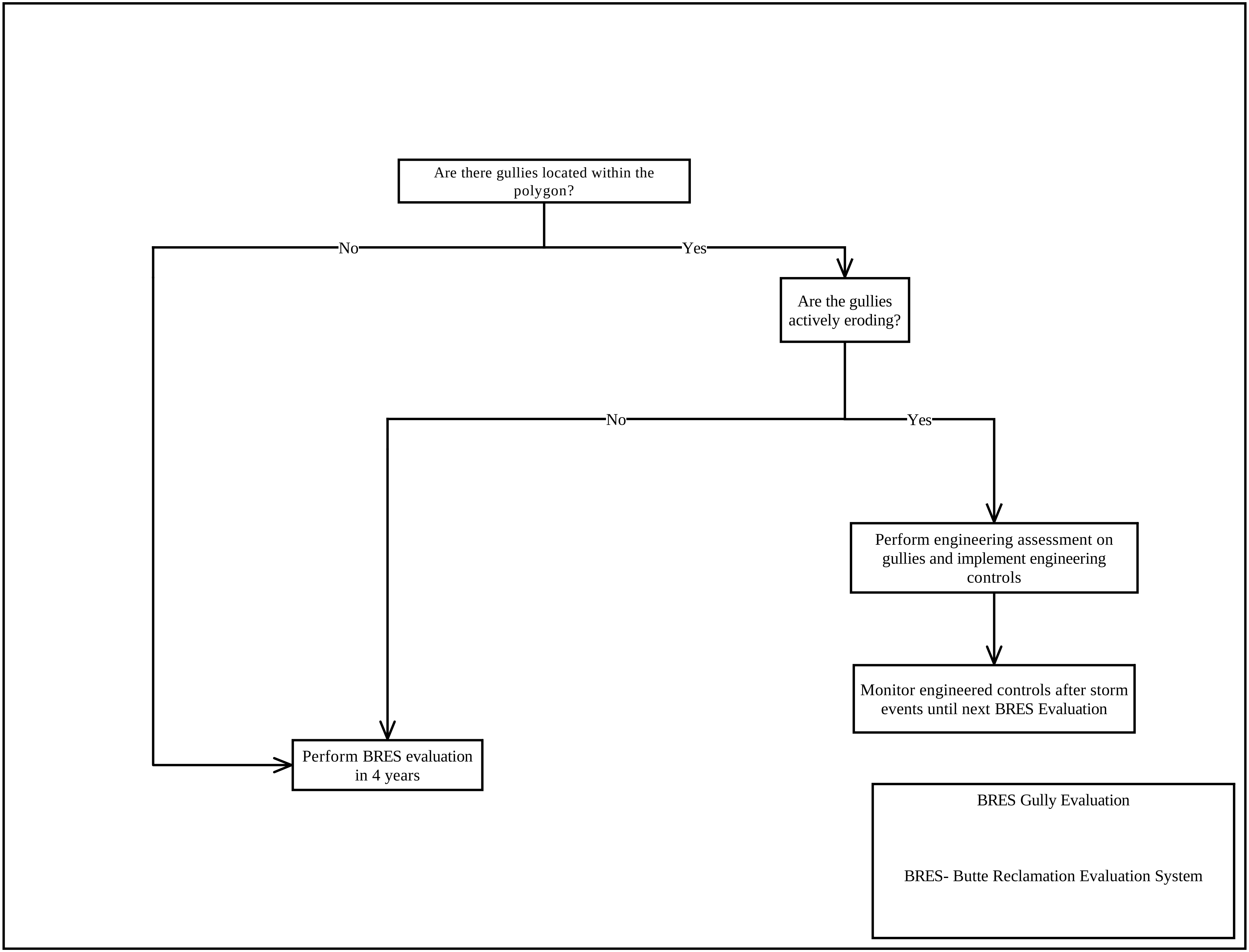
BRES Barren Area Evaluation

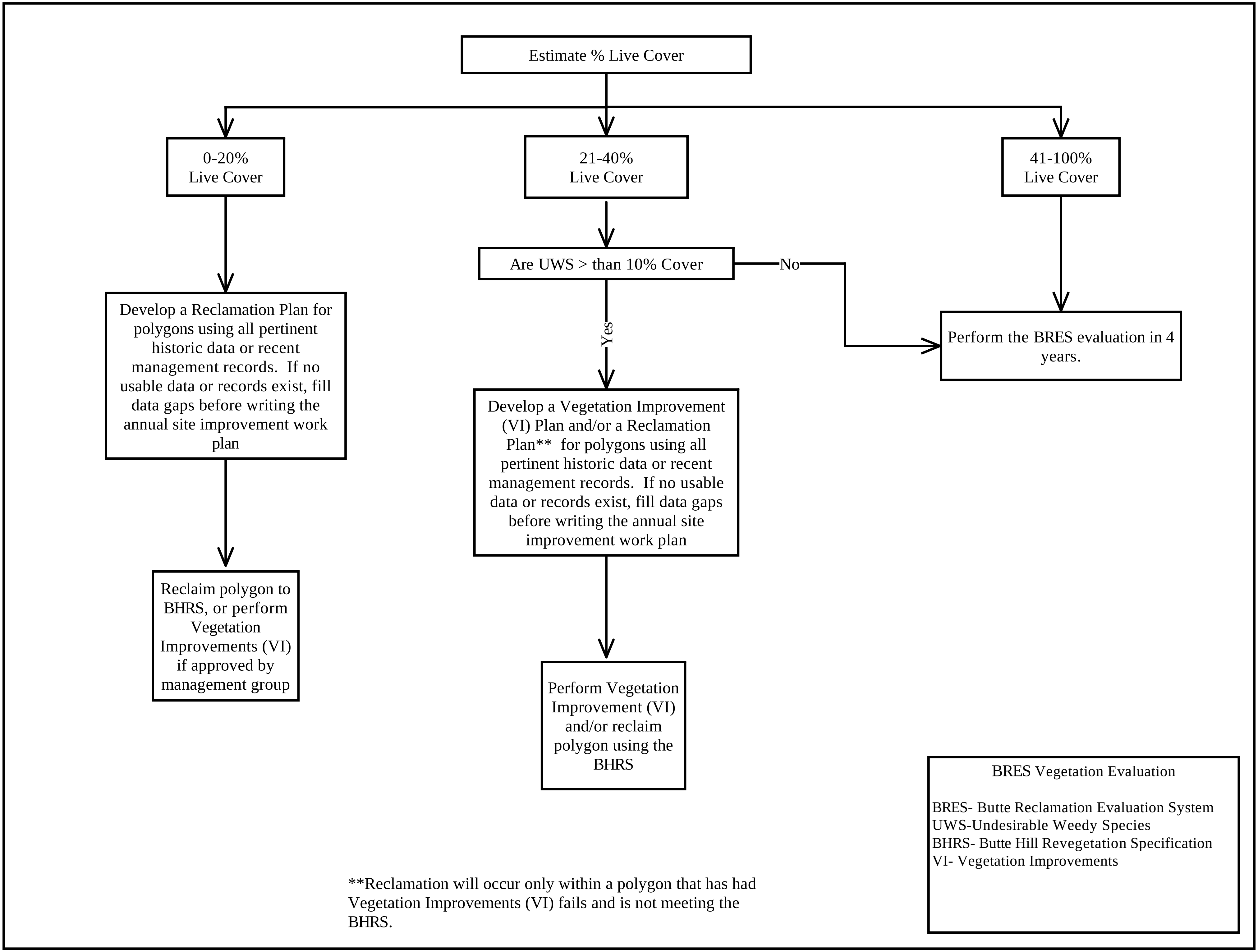
BHRS- Butte Hill Revegetation Specification
BRES- Butte Reclamation Evaluation System
SAP- Sampling and Analysis Plan

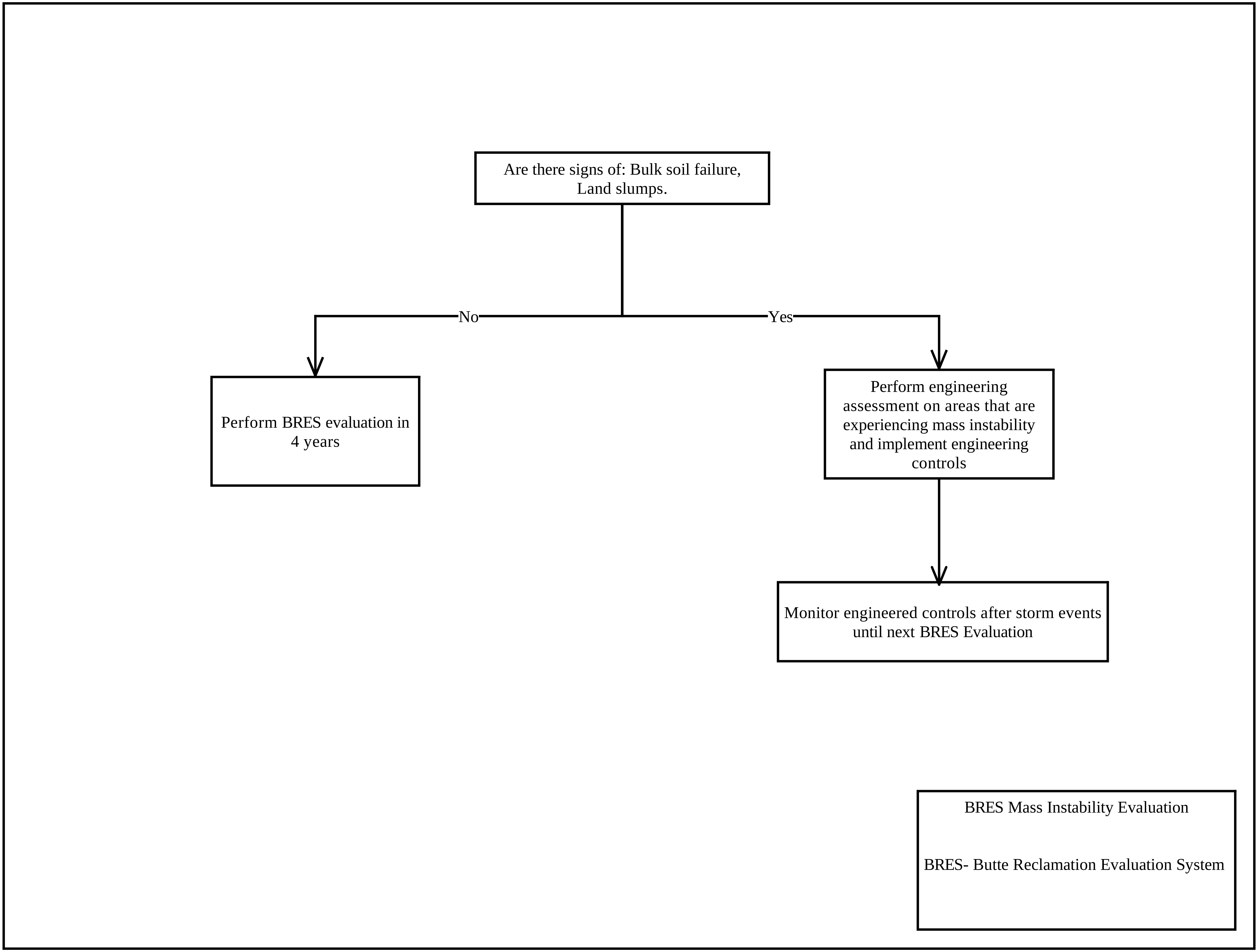


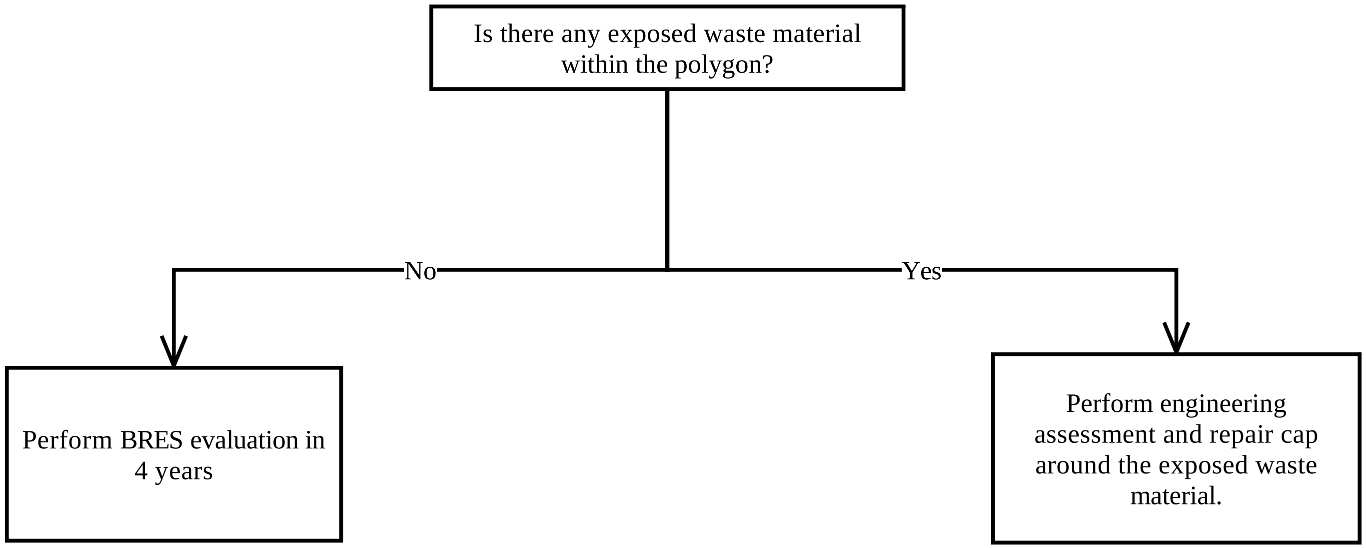
BRES Erosion Evaluation

BMP- Best Management Practice
BRES- Butte Reclamation Evaluation System


Are there gullies located within the polygon?
No
Yes
Are the gullies actively eroding?
No
Yes
Perform engineering assessment on gullies and implement engineering controls
Monitor engineered controls after storm events until next BRES Evaluation
Perform BRES evaluation in 4 years
BRES Gully Evaluation
BRES- Butte Reclamation Evaluation System


Estimate % Live Cover
0-20% Live Cover
21-40% Live Cover
41-100% Live Cover
Develop a Reclamation Plan for polygons using all pertinent historic data or recent management records. If no usable data or records exist, fill data gaps before writing the annual site improvement work plan
Are UWS > than 10% Cover
No
Yes
Perform the BRES evaluation in 4 years.
Develop a Vegetation Improvement (VI) Plan and/or a Reclamation Plan** for polygons using all pertinent historic data or recent management records. If no usable data or records exist, fill data gaps before writing the annual site improvement work plan
Reclaim polygon to BHRS, or perform Vegetation Improvements (VI) if approved by management group
Perform Vegetation Improvement (VI) and/or reclaim polygon using the BHRS
BRES Vegetation Evaluation
BRES- Butte Reclamation Evaluation System
UWS-Undesirable Weedy Species
BHRS- Butte Hill Revegetation Specification
VI- Vegetation Improvements
**Reclamation will occur only within a polygon that has had Vegetation Improvements (VI) fails and is not meeting the BHRS.


Are there signs of: Bulk soil failure, Land slumps.
No
Yes
Perform BRES evaluation in 4 years
Perform engineering assessment on areas that are experiencing mass instability and implement engineering controls
Monitor engineered controls after storm events until next BRES Evaluation
BRES Mass Instability Evaluation
BRES- Butte Reclamation Evaluation System



BRES Exposed Waste Material Evaluation

BRES Appendix D

BRES Field Form

BRES FIELD FORM

Site Name: ______________________ **Date:** ___________

Team Members (Circle your name): ____

Number of Polygons: _____ Slope: __________ Aspect: __________ Area Description: ____________

Polygon Evaluation	1	2	3
Vegetation (% live)			
Erosion (BLM score)			
% live weedy species			

Vegetation: % of ground covered by:	POLYGON 1	2	3
Live (desirable) species			
*Live (undesirable weedy) species			
*Noxious weeds			
TOTAL % LIVE			
Litter			
Rocks > 2”			

*Up to 5% of undesirable species and 0% of noxious weeds may count toward live cover.

Erosion (BLM Form)	POLYGON 1	2	3
Surface Litter			
Surface Rock Movement			
Pedestalling			
Flow Patterns			
Rills			
Gullies			
Soil Movement			

1. Percent live: please check appropriate category:

1 ☐ **0-20** ☐ **21-39** ☐ **40-100**
2 ☐ **0-20** ☐ **21-39** ☐ **40-100**
3 ☐ **0-20** ☐ **21-39** ☐ **40-100**

2. Total BLM score 1____, 2____, 3____. Please check appropriate category.

1 ☐ **0-55** ☐ **56-100**
2 ☐ **0-55** ☐ **56-100**
3 ☐ **0-55** ☐ **56-100**

Species Present:	Dominant	Frequent	Infreq.
Sheep fescue			
Crested wheatgrass			
Slender wheatgrass			
Yellow sweetclover			
Alfalfa			
Other:			
____________			
____________			
____________			
____________			

Use polygon number in boxes

Weeds Present:	Dominant	Frequent	Infreq.
Spotted knapweed			
Dalmation toadflax			
Cheatgrass			
Baby’s breath			
Kochia			
Thistle			
Other:			
____________			
____________			
____________			

Use polygon number in boxes

Other BRES Trigger Items
Identify trigger areas (using #) on air photo

3. Site Edges: Are polygon edges (outer edges of site only) significantly different than remainder of the polygon?
Y_____ N_____ (check applicable items)

☐ **lime rock barrier** ☐ **depositional area**
☐ **more weeds** ☐ **steeper slope**
☐ **increased erosion** ☐ **less vegetation**
☐ **gullies** ☐ **other**______________________

Estimate width of affected edge ________

4. Exposed Waste Material? Y_____ N_____

- Estimated pH_____
- Approximate area _____
- Number of areas with exposed waste _____

5. Is there evidence of: Y_____ N_____

☐ **bulk soil failure** ☐ **land slumps**
☐ **subsidence**

6. Barren Areas: Y_____ N_____
● At Least 75 ft^2 ● Not a rock outcrop
● Less than 10 % total cover (live & litter)
Number of barren areas ______
Do barren areas cover over 25% of polygon? Y____N____
Polygon barren area(s) located in (circle) 1 2 3

7. Gullies (over 6” in depth):
Y_____ N_____
Are any gullies actively eroding?
Y_____ N_____
Number of gullies ______

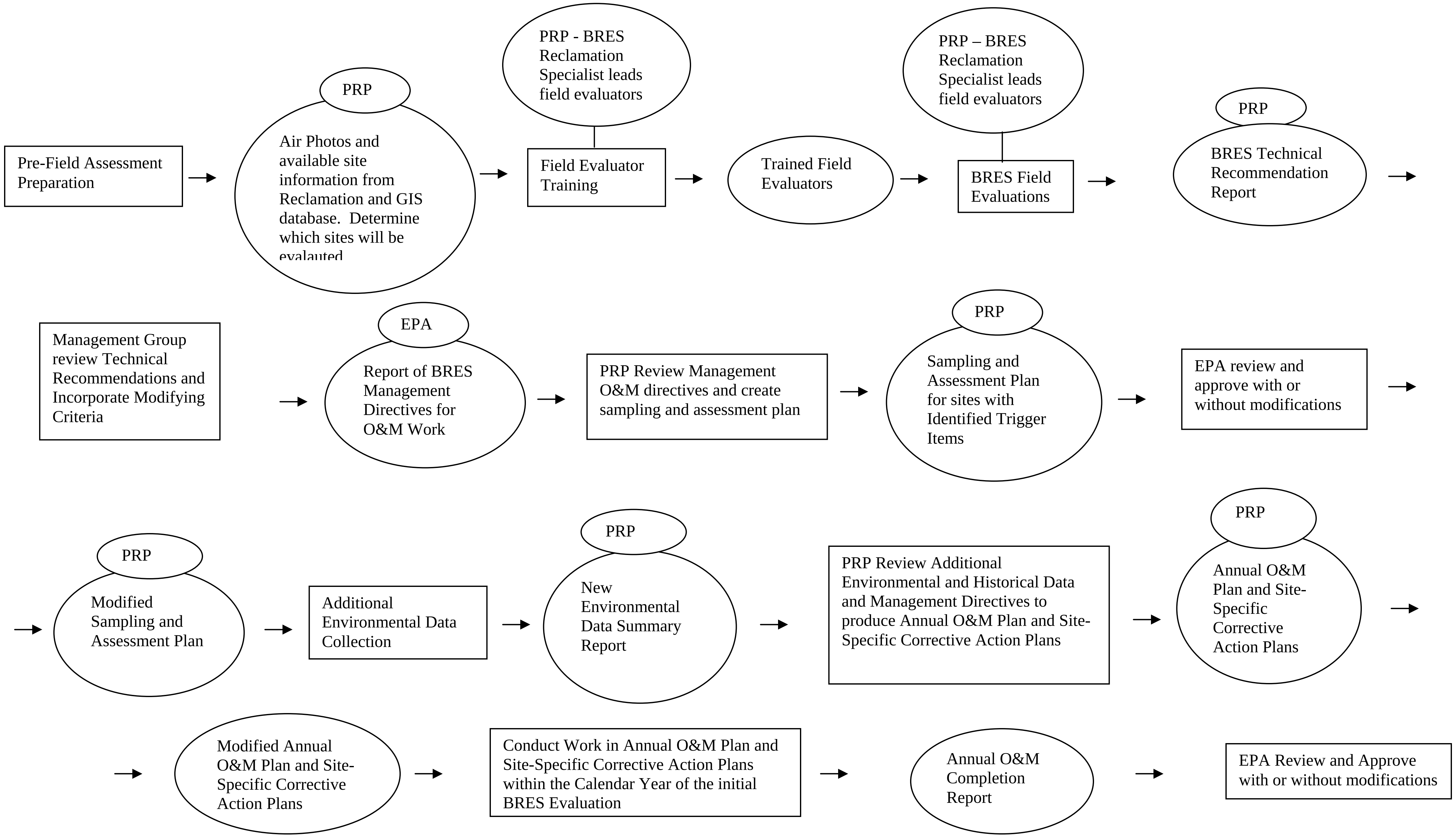
Comments.

Additional Vegetation:

Species	Dominant	Frequent	Infreq.

BRES Appendix E

Annual BRES Process Flow Chart



Annual BRES Process Flowchart

BRES Appendix F

BRES Engineered Cap Integrity Field Form

Butte Reclamation Evaluation System (BRES)
Raw Data Field Form for Engineered Caps

Date______________________ **Site Name/Number**____
Field Team Members____
Area Description____

Rock Cap
Type of rock (limestone, pit run gravel, etc.)____ Design thickness________
Surface staining: None_____ Moderate_____ Excessive_____ Describe stain pattern/color__________________________

Displaced rock: None_____ Moderate_____ Excessive_____ Pattern of displacement: Localized_____ Universal______
Describe movement (storm water rills, steep slope instability, vehicular, etc.)____

Does rock cap have a geotextile liner? Yes_____ No_____ If yes, describe condition of liner (good, exposed, torn, poorly anchored, etc.)____
Exposed subgrade materials? Yes_____ No_____ Describe exposed subgrade if noted (area, localized, dispersed, etc.)____

General comments regarding rock cap:____

Concrete or Shotcrete Cap
Did design specify for sulfate resistant concrete? Yes_____ No_____ Unknown_____ Design thickness_______________
Type of reinforcing (fiber, re-bar, welded wire fabric.)____________________________ Control joints? Yes____ No_____
Surface staining: None_____ Moderate_____ Excessive_____ Describe stain pattern/color__________________________

Surface cracking: None_____ Moderate_____ Excessive_____ Describe the approximate frequency, length, and average thickness of the cracks if noted.____

Surface spalling: None_____ Moderate_____ Excessive_____ Describe the spalling pattern if noted.__________________

Exposed subgrade materials? Yes_____ No_____ Describe exposed subgrade if noted (area, localized, dispersed, etc.)____

Evidence of undercutting at edges of cap? None_____ Moderate_____ Excessive_____ Describe undercutting of subgrade soil at edges of cap if noted____
General comments regarding concrete/shotcreet cap:____

Asphalt Cap
Design Thickness_____ Is there a layer of base course under asphalt? Yes_____ No_____ Base course thickness______
Surface cracking: None_____ Moderate_____ Excessive_____ Describe the frequency, length, and average thickness of the cracks if noted.____

Holes in asphalt? Yes_____ No_____ Describe number, size, shape of holes in asphalt if noted.______________________

Exposed subgrade materials? Yes_____ No_____ Describe exposed subgrade if noted (area, localized, dispersed, etc.)____

Evidence of undercutting at edges of cap? None_____ Moderate_____ Excessive_____ Describe undercutting of subgrade soil at edges of cap if noted____
General comments regarding asphalt cap:____

BRES Appendix G

BPSOU Plant Species Classes

BSPOU Plant Species Classes

Species Name	Life form Code	Life form Class	Common Name	Desirability Code
Achillea millefolium	PF	Perennial Forbs	Yarrow	AS
Agoseris glauca	PF	Perennial Forbs	False Dandelion	AS
Agropyron cristatum	PG	Perennial Grasses	Crested Wheatgrass	AS
Agropyron dasystachyum	PG	Perennial Grasses	Thickspike Wheatgrass	AS
Agropyron elongatum	PG	Perennial Grasses	Tall Wheatgrass	AS
Agropyron intermedium	PG	Perennial Grasses	Intermediate Wheatgrass	AS
Agropyron repens	PG	Perennial Grasses	Quackgrass	AS
Agropyron smithii	PG	Perennial Grasses	Western Wheatgrass	AS
Agropyron spicatum	PG	Perennial Grasses	Bluebunch Wheatgrass	AS
Agropyron spp.	PG	Perennial Grasses	Wheatgrass	AS
Agropyron trachycaulum	PG	Perennial Grasses	Slender Wheatgrass	AS
Agrostis alba	PG	Perennial Grasses	Redtop	AS
Agrostis scabra	PG	Perennial Grasses	Ticklegrass	AS
Agrostis tenuis	PG	Perennial Grasses	Colonial Bentgrass	AS
Allium cernuum	PF	Perennial Forbs	Nodding Onion	AS
Alopecurus pratensis	PG	Perennial Grasses	Meadow Foxtail	AS
Alyssum alyssoides	AF	Annual Forbs	Alyssum	UWS
Alyssum desertorum	AF	Annual Forbs	Alyssum	UWS
Alyssum murale	AF	Annual Forbs	Alyssum	UWS
Amaranthus albus	AF	Annual Forbs	White Pigweed	UWS
Amaranthus retroflexus	AF	Annual Forbs	Pigweed	UWS
Andropogon scoparius	PG	Perennial Grasses	Little Bluestem	AS
Antennaria rosea	PF	Perennial Forbs	Pussy Toes	AS
Arabis glabra	PF	Perennial Forbs	Smooth Rockress	AS
Arabis holboellii	PF	Perennial Forbs	Rockcress	AS
Arabis sp.	PF	Perennial Forbs	Rockcress	AS
Artemisia absinthium	BF	Biennial Forbs	Wormwood	UWS
Artemisia frigida	SS	Semi-shrubs	Pasture Sagewort	AS
Artemisia longifolia	S	Shrubs	Longleaf Sagewort	AS
Artemisia ludoviciana	PF	Perennial Forbs	Lousiana Sagewort	AS
Artemisia tridentata	S	Shrubs	Big Sagebrush	AS
Aster adscendens	PF	Perennial Forbs	Aster	AS
Aster sp.	PF	Perennial Forbs	Aster	AS
Astragalus adsurgens	PF	Perennial Forbs	Milkvetch	AS
Astragalus cicer	PF	Perennial Forbs	Cicer Milkvetch	AS
Atriplex hastata	AF	Annual Forbs	Orache	UWS
Avena sativa	AG	Annual Grasses	Wild Oats	UWS
Balsamhorriza saggitata	PF	Perennial Forb	Arrowleaf balsamroot	AS
Barbarea orthoceras	AF	Annual Forbs	Barbarea	UWS
Berberis repens	PF	Perennial Forb	Oregon grape	AS
Berteroa incana	AF	Annual Forbs	Berteroa	UWS
Brassica rapa	AF	Annual Forbs	Rape Mustard	UWS
Brassica sp.	AF	Annual Forbs	Rape Mustard	UWS
Bromus biebersteinii	PG	Perennial Grasses	Meadow Brome	AS
Bromus inermis	PG	Perennial Grasses	Smooth Brome	AS
Bromus japonicus	AG	Annual Grasses	Japanese Brome	UWS
Bromus marginatus	PG	Perennial Grasses	Mountain Brome	AS
Bromus tectorum	AG	Annual Grasses	Cheatgrass	UWS
Camelina microcarpa	AF	Annual Forbs	Littleseed False Flax	UWS
Capsella bursa-pastoris	AF	Annual Forbs	Shepherd's Purse	UWS
Cardaria draba	PF	Perennial Forbs	Whitetop	NXW
Carduus nutans	BF	Biennial Forbs	Musk Thistle	UWS

BSPOU Plant Species Classes

Species Name	Life form Code	Life form Class	Common Name	Desirability Code
ssp.macrolepis				
Centaurea cyanus	AF	Annual Forbs	Bachelor's Buttons	UWS
Cercocarpus ledifolius	S	Shrub	Mountain Mahogony	AS
Chaenactis douglasii	PF	Perennial Forbs	Chaenactis	AS
Chenopodium album	AF	Annual Forbs	Goosefoot	UWS
Chenopodium leptophyllum	AF	Annual Forbs	Narrowleaf Goosefoot	UWS
Chenopodium pratericola	AF	Annual Forbs	Goosefoot	UWS
Chenopodium sp.	AF	Annual Forbs	Goosefoot	UWS
Chrysothamnus nauseosus	S	Shrubs	Rubber Rabbitbrush	AS
Cirsium arvense	PF	Perennial Forbs	Canada Thistle	NXW
Cirsium undulatum	PF	Perennial Forbs	Prairie Thistle	AS
Cleome serrulata	AF	Annual Forbs	Rocky Mountain Bee Plant	AS
Collomia linearis	AF	Annual Forbs	Collomia	AS
Comandra umbellata	PF	Perennial Forbs	Bastard Toadflax	AS
Convolvulus arvensis	PF	Perennial Forbs	Field Bindweed	NXW
Dactylis glomerata	PG	Perennial Grasses	Orchard Grass	AS
Dasiphora fruticosa	S	Shrub	Shrubby Cinquefoil	AS
Deschampsia caespitosa	PG	Perennial Grasses	Tufted Hairgrass	AS
Descurainia pinnata	AF	Annual Forbs	Tansy Mustard	UWS
Descurainia richardsonii	AF	Annual Forbs	Tansy Mustard	UWS
Descurainia sophia	AF	Annual Forbs	Tansy Mustard	UWS
Distichlis spicata	PG	Perennial Grasses	Inland Saltgrass	AS
Dougalsia Montana	PF	Perennial Forb	Douglasia	AS
Dracocephalum parviflorum	AF	Annual Forbs	Dragonhead	AS
Echinacea sp.	PF	Perennial Forbs	Purple Prairie Coneflower	AS
Elymus canadensis	PG	Perennial Grasses	Canada Wildrye	AS
Elymus cinereus	PG	Perennial Grasses	Great Basin Wildrye	AS
Elymus junceus	PG	Perennial Grasses	Russian Wildrye	AS
Epilobium angustifolium	PF	Perennial Forbs	Fireweed	AS
Epilobium brachycarpum	AF	Annual Forbs	Willow Herb	AS
Epilobium ciliatum	PF	Perennial Forbs	Willow Herb	AS
Epilobium paniculatum	AF	Annual Forbs	Willow Herb	AS
Erigeron compositus	PF	Perennial Forbs	Daisy Fleabane	AS
Erigeron disectum	PF	Perennial Forb	Cutleaf daisy	AS
Erigeron pinnatisectus	PF	Perennial Forbs	Daisy Fleabane	AS
Erigeron sp.	PF	Perennial Forbs	Daisy Fleabane	AS
Eriogonum sp.	PF	Perennial Forb	Wild Buckwheat	AS
Erodium cicutarium	PF	Perennial Forbs	Cranesbill	UWS
Erysimum asperum	PF	Perennial Forbs	Western Wallfower	AS
Erysimum repandum	AF	Annual Forbs	Wallflower	AS
Eschscholtzia californica	AF	Annual Forbs	California Poppy	AS
Festuca ovina	PG	Perennial Grasses	Sheep Rescue	AS
Festuca pratensis	PG	Perennial Grasses	Meadow Fescue	AS
Festuca scabrella	PG	Perennial Grasses	Rough Fescue	AS
Filago arvensis	AF	Annual Forbs	Filago	UWS
Fraxinus pennsylvanica	S	Shrub	Mountain Ash	AS
Gaillardia aristata	PF	Perennial Forbs	Blanket Flower	AS
Gayophytum ramosissimum	AF	Annual Forbs	Ground Smoke	AS

BSPOU Plant Species Classes

Species Name	Life form Code	Life form Class	Common Name	Desirability Code
Geranium viscosissimum	PF	Perennial Forbs	Geranium	AS
Grindelia squarrosa	PF	Perennial Forbs	Curlycup Gumweed	AS
Gypsophila paniculata	PF	Perennial Forbs	Baby's Breath	UWS
Haplopappus acaulis Stenotus acaulis	PF	Perennial Forb	yellow tufted daisy	AS
Helianthus annuus	AF	Annual Forbs	Annual Sunflower	UWS
Heliomeris multiflora	PF	Perennial Forbs	Snowy Goldeneye	AS
Heterotheca villosa	PF	Perennial Forbs	Golden Aster	AS
Hordeum jubatum	PG	Perennial Grasses	Foxtail Barley	AS
Iva axillaris	PF	Perennial Forbs	Poverty Sumpweed	AS
Juncus balticus	PG	Perennial Grasses	Baltic Rush	AS
Juniperus horizontalis	S	Shrub	Creeping Juniper	AS
Juniperus scopulorum	T	Trees	Rocky Mountain Juniper	AS
Kochia scoparia	AF	Annual Forbs	Kochia	UWS
Lactuca serriola	AF	Annual Forbs	Prickly Lettuce	UWS
Lappula redowskii	AF	Annual Forbs	Stickseed	UWS
Lepidium densiflorum	AF	Annual Forbs	Pepperweed	UWS
Lepidium perfoliatum	AF	Annual Forbs	Pepperweed (clasping)	UWS
Lepidium ramosissimum	AF	Annual Forbs	Pepperweed	UWS
Linaria dalmatica	PF	Perennial Forbs	Spotted Toadflax	NXW
Linaria vulgaris	PF	Perennial Forbs	Butter and Eggs	UWS
Linum lewisii	PF	Perennial Forbs	Blue Flax	AS
Linum sp.	PF	Perennial Forbs	Flax	AS
Lithospermum ruderale	PF	Perennial Forbs	Puccoon	AS
Lotus corniculatus	PF	Perennial Forbs	Birdsfoot Trefoil	AS
Lupinus sp.	PF	Perennial Forb	Lupine	AS
Lychnis alba	AF	Annual Forbs	Lychnis	AS
Machaeranthera canescens	PF	Perennial Forbs	Machaeranthera	AS
Malva rotundifolia	PF	Perennial Forbs	Cheese Weed	UWS
Matricaria matricarioides	AF	Annual Forbs	Pineapple Weed	UWS
Medicago lupulina	PF	Perennial Forbs	Black Medic	AS
Medicago sativa	PF	Perennial Forbs	Alfalfa	AS
Melilotus alba	BF	Biennial Forbs	White Sweetclover	AS
Melilotus officinalis	BF	Biennial Forbs	Yellow Sweetclover	AS
Mentzelia dispersa	AF	Annual Forbs	Stickleaf	AS
Mentzelia laevicaulis	BF	Biennial Forbs	Evening Star	AS
Oenothera caespitosa	PF	Perennial Forbs	Gumbo Lily	AS
Oenothera villosa	BF	Biennial Forbs	Evening Primrose	AS
Onobrychis viciaefolia	PF	Perennial Forbs	Sanfoin	AS
Onopordum acanthium	BF	Biennial Forbs	Scotch Thistle	UWS
Oryzopsis hymenoides	PG	Perennial Grasses	Indian Ricegrass	AS
Oxytropis sp.	PF	Shrub	Locoweed	AS
Panicum capillare	AG	Annual Grasses	Witchgrass	UWS
Papaver sp.	AF	Annual Forbs	Poppy	AS
Penstemon sp.	PF	Perennial Forbs	Beard Tongue	AS
Phacelia Hastata	PF	Perennial Forbs	Phacelia	AS
Phacelia heterophylla	PF	Perennial Forbs	Phacelia	AS
Phleum pratense	PG	Perennial Grasses	Timothy	AS
Pinus contorta	T	Trees	Lodgepole Pine	AS
Pinus flexelis	T	Tree	Limber Pine	AS
Pinus ponderosa	T	Tree	Ponderosa Pine	AS

BSPOU Plant Species Classes

Species Name	Life form Code	Life form Class	Common Name	Desirability Code
Poa ampla	PG	Perennial Grasses	Big Bluegrass	AS
Poa compressa	PG	Perennial Grasses	Canada Bluegrass	AS
Poa interior	PG	Perennial Grasses	Interior Bluegrass	AS
Poa palustris	PG	Perennial Grasses	Fowl Bluegrass	AS
Poa pratensis	PG	Perennial Grasses	Kentucky Bluegrass	AS
Poa secunda	PG	Perennial Grasses	Sandberg Bluegrass	AS
Poa sp.	PG	Perennial Grasses	Bluegrass	AS
Polygonum aviculare	AF	Annual Forbs	Knotweed	UWS
Polygonum convolvulus	AF	Annual Forbs	Black Blindweed	UWS
Polygonum lapathifolium	AF	Annual Forbs	Knotweed	UWS
Polygonum sawatchense	AF	Annual Forbs	Knotweed	AS
Populus acuminata	T	Tree	black cottonwood	AS
Populus angustifolia	T	Tree	narrowleaf cottonwood	AS
Populus tremuloides	T	Trees	Quaking Aspen	AS
Potentilla norvegica	PF	Perennial Forbs	Cinquefoil	AS
Potentilla sp.	PF	Perennial Forbs	Cinquefoil	AS
Prunus americana	S	Shrubs	Wild Plum	AS
Prunus virginiana	S	Shrubs	Chokecherry	AS
Pseudotsuga menziessi	T	Tree	Douglass Fir	AS
Puccinellia nuttalliana	PG	Perennial Grasses	Alkaligrass	AS
Purshia tridentate	S	Shrub	Bitterbrush	AS
Ratibida columnifera	PF	Perennial Forbs	Prairie Coneflower	AS
Ribes sp.	S	Shrub	gooseberry/currant	AS
Rosa woodsii	S	Shrub	Wild Rose	AS
Rubus ideaus	S	Shrub	raspberry	AS
Rumex acetosella	PF	Perennial Forbs	Sheep Sorrel	UWS
Rumex crispus	PF	Perennial Forbs	Curlyleaf Dock	UWS
Rumex salicifolius	PF	Perennial Forbs	Willowleaf Dock	AS
Rumex sp.	PF	Perennial Forbs	Dock	AS
Salix sp.	S	Shrub	Willows	AS
Salsola iberica	AF	Annual Forbs	Russian Thistle	UWS
Setaria viridis	AG	Annual Grasses	Green Foxtail	UWS
Silene cserei	AF	Annual Forbs	Catchfly	UWS
Silene noctiflora	AF	Annual Forbs	Catchfly	UWS
Silene vulgaris	AF	Annual Forbs	Catchfly	UWS
Sisymbrium altissimum	AF	Annual Forbs	Tumbling Hedge Mustard	UWS
Sisymbrium loeselii	AF	Annual Forbs	Hedge Mustard	UWS
Sitanion hystrix	PG	Perennial Grasses	Squirreltail Grass	AS
Solanum triflorum	AF	Annual Forbs	Nightshade	UWS
Solidago gigantea	PF	Perennial Forbs	Tall Goldenrod	AS
Stipa columbiana	PG	Perennial Grasses	Columbia Needlegrass	AS
Stipa comata	PG	Perennial Grasses	Needle-and-Thread Grass	AS
Stipa sp.	PG	Perennial Grasses	Needlegrass	AS
Stipa viridula	PG	Perennial Grasses	Green Needlegrass	AS
Taraxacum officinale	PF	Perennial Forbs	Common Dandelion	UWS
Thlaspi arvense	AF	Annual Forbs	Pennycress	UWS
Tragopogon dubius	BF	Biennial Forbs	Salsify	UWS
Trifolium hybridum	PF	Perennial Forbs	Alsike Clover	AS
Trifolium pratense	PF	Perennial Forbs	Red Clover	AS
Trifolium repens	PF	Perennial Forbs	White Clover	AS
Triticum aestivum	AG	Annual Grasses	Wheat	UWS
Unknown dicot	PF	Perennial Forbs		AS

BSPOU Plant Species Classes

Species Name	Life form Code	Life form Class	Common Name	Desirability Code
Unknown garden scroph	PF	Perennial Forbs		AS
Verbascum thapsus	BF	Biennial Forbs	Common Mullein	UWS
Verbena bracteata	AF	Annual Forbs	Creeping Charlie	UWS
Verbena hastata	PF	Perennial Forbs	Vervain	AS
Vulpia octoflora	AG	Annual Grasses	Six-weeks Fescue	AS
Vaccinium scoparium	S	Shrub	Grouse whortleberry	AS

Notes:

Lifeform Code:

PG-Perennial Grasses
AS- Annual Grasses
PF-Perennial Forbs
AF- Annual Forbs
BF-Biennial Forbs
SS- Semi-shrubs
S-Shrubs
T- Trees

Desirability Code:

AS-Acceptable species.
UWS- Undesirable weedy species
NXS-Noxious weeds

BRES Appendix H

Noxious Weed List for Montana and Butte-Silver Bow County

Noxious Weed List for Montana and Butte-Silver Bow County

Category I

Category I noxious weeds are weeds that are currently established and generally widespread in many counties of the state. Management criteria include awareness and education, containment and suppression of existing infestations, and prevention of new infestations. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses.

- leafy spurge *Euphorbia esula*
- Canada thistle *Cirsium arvense*
- Russian knapweed *Centaurea repens*
- spotted knapweed *Centaurea maculosa*
- diffuse knapweed *Centaurea diffusa*
- field bindweed *Convolvulus arvensis*
- whitetop (hoary cress) *Cardaria draba*
- Dalmatian toadflax *Linaria dalmatica*
- St. Johnswort (goatweed) *Hypericum perforatum*
- sulfur cinquefoil *Potentilla recta*
- common tansy *Tanacetum vulgare*
- oxeye daisy *Chrysanthemum leucanthemum* L.
- houndstongue *Cynoglossum officinale* L.

Category II

Category II noxious weeds have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds are capable of rapid spread and invasion of lands, rendering lands unfit for beneficial uses. Management criteria include awareness and education, monitoring and containment of known infestations and eradication where possible.

- dyer's woad *Isatis tinctoria*
- purple loosestrife or lythrum *Lythrum salicaria or Lythrum virgatum*
- tansy ragwort *Senecio jacobaea* L.
- meadow hawkweed complex *Hieracium pratense, H. floribundum, H. piloselloides*
- orange hawkweed *Hieracium aurantiacum* L.
- tall buttercup *Ranunculus acris* L.
- tamarisk (saltcedar) *Tamarix* spp.

Category III

Category III noxious weeds have not been detected in the state or may be found only in small, scattered, localized infestations. Management criteria include awareness and education, early detection and immediate action to eradicate infestations. These weeds are known pests in nearby states and are capable of rapid spread and render land unfit for beneficial uses.

- yellow starthistle *Centaurea solstitialis*
- common crupina *Crupina vulgaris*
- rush skeletonweed *Chondrilla juncea*

Category IV

County (Butte-Silver Bow County) declared noxious weeds.

- Baby's breath *Gysophila paniculated*
- Wild caraway *Carum carvi*
- Matrimony vine *Lycium balimisolium* L.

BRES Appendix I

BRES Erosion Condition Class Determination

BRES EROSION CONDITION CLASS DETERMINATION

SURFACE LITTER	No movement, or if present, less than 2 percent of the unattached litter has been translocated and redeposited against obstacles. 0 or 3	Between 2 and 10 percent of the unattached litter has been translocated and redeposited against obstacles. 6	Between 10 and 25 percent of the unattached litter has been translocated and redepostied against obstacles. 8	Between 25 and 50 percent of the unattached litter has been translocated and redeposited against obstacles. 11	More than 50 percent of the unattached litter has been translocated and redeposited against obstacles. 14
SURFACE ROCK MOVEMENT	No movement, or if present, less than 2 percent of the surface rock fragments show localized concentration. 0 or 2	Between 2 and 10 percent of the surface rock fragments show localized concentration. 5	Between 10 and 25 percent of the surface rock fragments show localized concentration. 8	Between 25 and 50 percent of the surface rock fragments show localized concentration. 11	More than 50 percent of the surface rock fragments show localized concentration. 14
PEDESTALLING	Pedestals are mostly less than 0.1 inches (2.5 mm) high and/or less frequent than 2 pedestals per 100 sq. ft. 0 or 3	Pedestals are mostly between 0.1 to 0.3 inches (2.5 to 8 mm) high and/or have a frequency of 2 to 5 pedestals per 100 sq. ft. 6	Pedestals are mostly between 0.3 and 0.6 inches (8 to 15 mm) high, and/or have a frequency of 5 to 7 pedestals per 100 sq. ft. 9	Pedestals are mostly between 0.6 to 1 inch (15 to 25 mm) high, and/or have a frequency of 7 to 10 pedestals per 100 sq. ft. 11	Pedestals are mostly over 1 inch (25 mm) high, and/or have a frequency of over 10 pedestals per 100 sq. ft. 14
FLOW PATTERNS	None, or if present, less than 2 percent of the surface area shows a flow pattern in which water flows over the ground surface for a distance at least 10 linear feet. 0 or 3	Between 2 and 10 percent of the surface area shows a flow pattern in which water flows over the ground surface for a distance of at least 10 linear feet. 6	Between 10 and 25 percent of the surface area shows a flow pattern in which water flows over the ground surface for a distance of at least 10 linear feet. 9	Between 25 and 50 percent of the surface area shows a flow pattern in which water flows over the ground surface for a distance of at least 10 linear feet. 12	Over 50 percent of the surface area shows a flow pattern in which water flows over the ground surface for a distance of at least 10 linear feet. 15
RILLS depth	Rills, if present, are mostly less than 0.5 in. (13mm) deep 0 to 2	Rills are mostly 0.5 to 1 in. (13mm to 25mm) deep. 3	Rills are mostly 1 to 1.5 in. (25mm to 38mm) deep. 4 to 5	Rills are mostly 1.5 to 3 in. (38mm to 76mm) deep. 6	Rills are mostly 3 to 6 in. (76mm to 152mm) deep. 7
RILLS frequency	Rills, if present, are generally found at intervals over 15 ft. 0 to 2	Rills, if present, are generally found at intervals over 10 ft. 3	Rills, if present, are generally found at intervals over 5 ft. 4 to 5	Rills, if present, are generally found at intervals between 2 to 5 ft. 6	Rills, if present, are generally found at intervals between 0 to 2 ft. 7
GULLIES depth	Gullies, if present, less than 2 percent of the channel bed and walls show active erosion. 0 to 2	Between 2 and 5 percent of the channel bed and walls show active erosion. 3	Between 5 and 10 percent of the channel bed and walls show active erosion. 4 to 5	Between 10 and 50 percent of the channel bed and walls show active erosion. 6	Over 50 percent of the channel bed and walls show active erosion. 7
GULLIES frequency	Gullies, if present, make up less than 2 percent of the area. 0 to 2	Gullies make up between 2 to 5 percent of the total area. 3	Gullies make up between 5 to10 percent of the total area. 4 to 5	Gullies make up between 10 to 50 percent of the total area. 6	Gullies make up greater than 50 percent of the total area. 7
SOIL MOVEMENT	Depth of deposits around obstacles is between 0 and 0.1 inches (0 to 2.5 mm). 0 or 3	Depth of deposits around obstacles is between 0.1 and 0.2 inches (2.5 to 5mm). 5	Depth of deposits around obstacles 0.2 and 0.4 inches (5 to 10 mm) 8	Depth of deposits around obstacles is between 0.4 and 0.8 inches (10 to 20 mm). 11	Depth of deposits around obstacles is over 0.8 inches (20 mm). 14