

Plateau Mining Corporation
Willow Creek Mine
C/007/0038

Phase II Bond Release Application

May 2012

C/007/038 Incoming

#4094

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**PLATEAU
MINING
CORPORATION**

RECEIVED

MAY 04 2012

DIV. OF OIL, GAS & MINING

May 1, 2012

Mr. Daron Haddock
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Re: Phase II Bond Release Application, Plateau Mining Corporation, Willow Creek Mine, C/007/0038

Dear Mr. Haddock:

Plateau Mining Corporation is herewith submitting three review copies of the Willow Creek Mine Phase II Bond Release Application.

This application includes the C 1 and C2 forms as required by the Division as well as replacement pages and new additions to the permit.

If you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,



Dennis N. Ware
Company Representative

Enclosures

Enviro/PermitActions/WillowCreek/Phase.II BondRelease/CoverLetter

File in:

- Confidential
- Shelf
- Expandable

Date Folder 050412 C/0070038

Incoming

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change New Permit Renewal Exploration Bond Release Transfer

Permittee: PLATEAU MINING CORPORATION

Mine: WILLOW CREEK MINE

Permit Number: C/007/0038

Title: PHASE II BOND RELEASE APPLICATION

Description, Include reason for application and timing required to implement:

PHASE II BOND RELEASE

Instructions: If you answer yes to any of the first eight questions, this application may require Public Notice publication.

- | | | |
|---|-----------------------------|---|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: _____ <input type="checkbox"/> increase <input type="checkbox"/> decrease. |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 2. Is the application submitted as a result of a Division Order? DO# _____ |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 4. Does the application include operations in hydrologic basins other than as currently approved? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 6. Does the application require or include public notice publication? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 7. Does the application require or include ownership, control, right-of-entry, or compliance information? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 9. Is the application submitted as a result of a Violation? NOV # _____ |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 10. Is the application submitted as a result of other laws or regulations or policies?
<i>Explain:</i> _____ |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 11. Does the application affect the surface landowner or change the post mining land use? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2) |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 13. Does the application require or include collection and reporting of any baseline information? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 15. Does the application require or include soil removal, storage or placement? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 16. Does the application require or include vegetation monitoring, removal or revegetation activities? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 17. Does the application require or include construction, modification, or removal of surface facilities? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 18. Does the application require or include water monitoring, sediment or drainage control measures? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 19. Does the application require or include certified designs, maps or calculation? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 20. Does the application require or include subsidence control or monitoring? |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No | 21. Have reclamation costs for bonding been provided? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 23. Does the application affect permits issued by other agencies or permits issued to other entities? |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | 24. Does the application include confidential information and is it clearly marked and separated in the plan? |

Please attach three (3) review copies of the application. If the mine is on or adjacent to Forest Service land please submit four (4) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

<u>Dennis N. Ware</u>	Company Representative	Date	<u>4/30/2012</u>
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 30th day of April, 2013

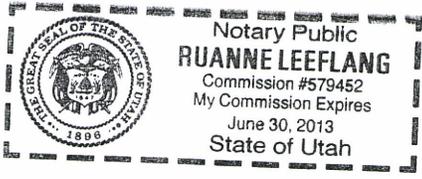
Notary Public: Ruanna LeeFlang, state of Utah.

My commission Expires: 6-30-13

Commission Number: 579452

Address: 25 No. Main

City: Orangeville State: Ut Zip: 84537



<p>For Office Use Only:</p>	<p>Assigned Tracking Number:</p>	<p>Received by Oil, Gas & Mining</p> <p style="text-align: center; color: red; font-weight: bold; font-size: 1.2em;">RECEIVED</p> <p style="text-align: center; color: blue; font-size: 1.2em;">MAY 04 2012</p> <p style="text-align: center; color: red; font-weight: bold;">DIV. OF OIL, GAS & MINING</p>
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LIST OF EXHIBITS

Field

<u>Exhibit No.</u>	<u>Exhibit Title</u>	<u>Location</u>
1	Ownership Information.....	Volume 4
2	Compliance Information.....	Volume 4
3	Public Notice and Proof of Publication, Hearing Notices and Documentation.....	Volume 4
4	Other Permits	Volume 4
5	Soils Information	Volumes 4 & 5
6	Vegetation, Fish, and Wildlife Information	Volume 5
7	Documentation of Existing Site Conditions.....	Volume 5
8	Deleted October 1999	
9	Geologic Information	Volume 6
10	Hydrologic Information	Volume 6
11	Geotechnical Investigations.....	Volumes 6 & 7
12	Deleted February 2000	
13	Drainage and Sediment Control Plan	Volumes 7 & 8
14	Willow Creek Realignment Plans	Volume 9
15	Blasting Plan	Volume 9
16	Subsidence Information	Volume 9
17	Bonding and Insurance Information.....	Volume 9
18	Bibliography.....	Volume 9
19	Castle Gate Information.....	Volumes 10 thru 14
20	Crandall Canyon Information	Volumes 15 & 16
21	Deleted October 1999	
22	Barn Canyon Shaft Information (Removed in March 2008).....	Volume 16
23	As-Built Reclamation, Willow Creek Mine, Mine Facilities Area.....	Volume 17
24	Phase II Bond Release.....	Volume 17

Exhibit 24

**Phase II Bond Release
Plateau Mining Corporation
Willow Creek Mine, C/007/0038**

May 2012

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Attachment 3.....Public Notice
Attachment 4.....Landowner and Government Agency Notification
Attachment 5.....Reclamation Certification
Attachment 6.....Bond Release Calculation
Attachment 7.....Phase II Maps

WILLOW CREEK MINE

Phase II Bond Release

May 2012

Introduction

The Willow Creek Mine is located approximately 4 miles north of Helper, Utah where the Price River and Willow Creek have cut canyons through the western Book Cliffs Coal Field.

Following the permanent cessation of operations in 2001, Plateau Mining Corporation began the reclamation of the Willow Creek Mine. By the fall of 2004 all demolition, earthwork, drainage construction and final seeding was completed on all but 1.17 acres referred to as the Loadout. In 2005 the demolition of the Loadout was completed and the area was reshaped and seeded in the spring of 2006.

Plateau Mining Corporation has completed phase II of the approved reclamation plan for the Willow Creek Mine. This is based on meeting the vegetation and water quality requirements for phase II reclamation in accordance with the approved reclamation plan on the entire remaining acreage within the disturbed area boundary. In order to receive phase II bond release the Permittee must demonstrate that, (1) the vegetation on the reclaimed site has been established in accordance with the approved reclamation plan and (2) that no part of the land is contributing suspended solids to the stream flow or runoff outside the permit area in excess of the requirements set by UCA 40-10-17(2) (j) of the Act or by R645-301-751 of the rules.

This phase II bond release application includes a year-four vegetation monitoring study (attachment 1), sediment yield calculations (attachment 2), public notice (attachment 3), landowner and government agency notification (attachment 4), reclamation certification (attachment 5), bond release calculations (attachment 6) and updated maps (attachment 7) showing the remaining disturbed area boundary, the dates of reclamation and seeding as well as dates of previous bond release actions.

During the preparation of this phase II bond release application it was discovered that some errors were made in the reporting of the acres that remain in the disturbed area boundary in previous phase I and phase III bond release submittals. The phase II bond release maps in attachment 7 to this application represent the accurate acreage remaining within the Willow Creek Permit disturbed area boundary.

Plateau Mining Corporation is seeking phase II bond release on all of the 95.40 acres

remaining in the Willow Creek Permit disturbed area boundary. The acres remaining in the disturbed area boundary are broken down as follows: 18.35 acres referred to as the Surface Facilities/Conveyor Corridor (phase I bond release in 2006), 38.34 acres referred to as the Preparation Plant, Loadout and Refuse Pile (phase I bond release in 2006 on all but 1.17 acres at the Loadout), 5.75 acres referred to as Gravel Canyon (phase I bond release in 2006) and 32.96 acres referred to as Crandall Canyon (phase I bond release received in 2010) for a total of 95.40 acres. This application for phase II bond release includes the entire 95.40 acres remaining in the disturbed area boundary. This application also requests phase I bond release for the 1.17 acres at the Loadout. In 2005 the demolition of the Loadout was completed and the area that was actually disturbed (only 0.22 acres), was reshaped and seeded in the spring of 2006.

The only regarding and reseeding that has taken place occurred in Crandall Canyon. The area around the upstream (western most) shaft (0.4 acres) was regarded and reseeded during the fall of 2005 to repair settlement of the fill in the shaft. The area around the downstream (eastern most) shaft (1.19) acres was regarded and reseeded in the summer of 2008 to repair settlement of the fill in the shaft. (See the Crandall Canyon As-Built Reclamation Treatment Areas – Phase II Bond Release map in attachment 7 for the specific area affected.)

There are no remaining sediment control structures (ponds, silt fences, straw bales or diversions) to be removed.

A performance bond in the amount of \$1,424,514 is currently held to ensure that reclamation is accomplished. Following the approval of this phase II bond release the bond will be reduced to \$489,166. The bond reduction calculation can be found in attachment 6 of this application.

In order to prepare for phase II bond release a year-four vegetation study was completed in 2008 by Mt. Nebo Scientific. Also, EarthFax Engineering prepared the sediment yield calculations for bond release. These two studies (attachments 1 and 2) used slightly different names to identify specific areas within the permit than those used on the maps and elsewhere in this application. The names used in the vegetation study and sediment yield calculations compared to those used on the maps and elsewhere in this bond release application are as follows:

<u>Vegetation Study and Sediment Yield Reference</u>	<u>Bond Release App / Maps Reference</u>
Conveyor Corridor	Surface Facilities/Conveyor Corridor
Refuse Pile	Prep. Plant, Loadout and Refuse Pile
Gravel Canyon	Gravel Canyon
Crandall Canyon	Crandall Canyon

Vegetation

Vegetation sampling on the reclaimed and reference areas at the Willow Creek Mine was conducted during the growing season of 2008 as a means to monitor the success of the revegetation and to determine whether or not phase II bond release was warranted. This study "Revegetation Monitoring at the Willow Creek Mine" was conducted by Mt. Nebo Scientific, Inc. for all reclaimed acres within the disturbed area boundary. This study is included in this application as attachment 1.

- This vegetation sampling report presents the methodology and data as required by the mining and reclamation plan. The data show that the revegetation at the Willow Creek Mine is progressing well and, based on the results of the study, phase II bond release is warranted.

At the end of the Summary and Conclusion section of the vegetation study (page 18) it states "In all instances, the reclaimed areas appear to be progressing very well to becoming communities that are diverse, effective and permanent as required by the state regulations for land once disturbed by coal mining operation."

Sediment Yield

EarthFax Engineering prepared sediment yield calculations for each of the areas where phase II bond release is being sought. The sediment yield calculations used the revised universal soil loss equation (RUSLE) under both pre-disturbance and post-reclamation conditions. These sediment yield calculations are included in this application as attachment 2. The factors involved are: 1) rainfall-runoff erosivity, 2) soil erodibility, 3) length of slope, 4) cover management, and 5) support practice. The sediment yield calculations show the sediment yield to be substantially less after reclamation than before the area was disturbed by mining. The sediment yield calculations can be found in attachment 2 of this application.

Conclusion

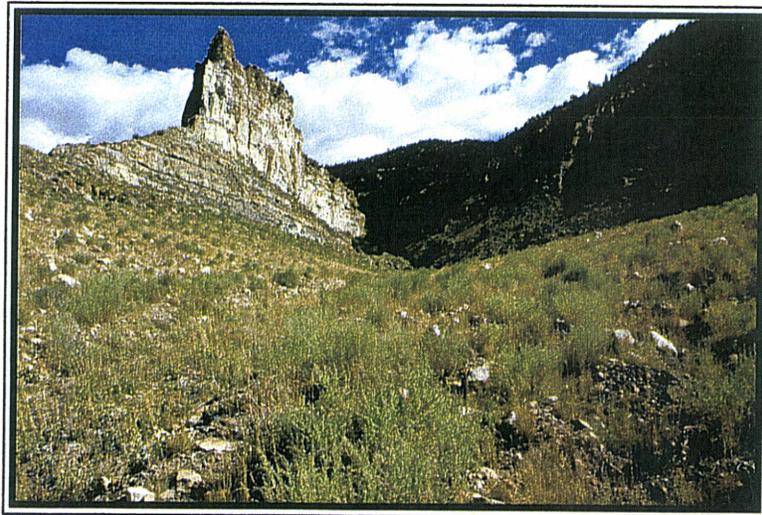
As authorized by R645-301-880.300, phase II bond release should be approved based on the Permittee meeting vegetation and water quality requirements in accordance with the mining and reclamation plan.

Attachment 1

**Phase II Bond Release
Year Four Vegetation Monitoring**

*Revegetation Monitoring
at the Willow Mine
Year 4: 2008*

*for
Plateau Mining Corporation*



Prepared by

MT. NEBO SCIENTIFIC, INC.

330 East 400 South, Suite 6

P.O. Box 337

Springville, Utah 84663

(801) 489-6937

by

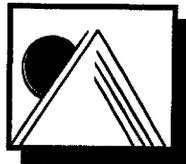
Patrick Collins, Ph.D.

for

PLATEAU MINING CORPORATION

P.O. Box 92

Orangeville, Utah 84537



May 2009

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INTRODUCTION

Scope

In 2004, reclamation and revegetation activities were completed at the Willow Creek Mine area including areas called Gravel Canyon, the Refuse Pile, the Conveyor Corridor, the Riparian Bottoms and Crandall Canyon. The scope of this report is to provide results from monitoring plant establishment and preliminary revegetation success for these sites after four years of growth and establishment.

History of Vegetation Sampling

The history of vegetation data that have been compiled at the Willow Creek Mine dates back to 1981 and earlier and is difficult to follow. There have been ownership and operator changes at the mine site over that time period. Moreover, quantitative data collection methodologies have changed over time, and in most cases there are explanations for the changes. The Willow Creek Mining and Reclamation Plan (MRP) attempts to explain these changes (MRP Section 3.2.1.2). To begin, the primary vegetation dataset and report that was used for permitting was prepared for the Price River Coal Company. This reference was called "*Vegetation Data Report of Price River Coal Company's Mine Area*" (Mariah Associates 1981). In 1988, a modification of this reference was used for permitting purposes for the Blackhawk Coal Company at the Willow

Creek Mine. Later in 1989, the Castle Gate Coal Company used some of these same datasets for the Willow Creek area with subsequent permitting changes submitted in 1994. Finally, more vegetation work was conducted by the State of Utah, Division of Oil, Gas & Mining' (DOGMs), Abandoned Mine Reclamation (AMR) program where some sites were reclaimed. These sites had been disturbed prior to the Surface Mining Control and Reclamation Act of 1977 (SMRCA); the MRP refers to them as the "Reclaimed Areas" and there is no longer a bond associated with them.

Many changes have been made regarding the vegetation success standards since those early studies. Willow Creek's MRP (Section 3.2.1.2) states that "*given the changes in regulatory requirements which have occurred since much of the data was originally collected and subsequent disturbance of many of the areas previously sampled at this location, the original data cannot be used directly to comply with current vegetation baseline requirements*". For this and other plant nomenclature problems in the original dataset, the 1981 data were no longer sufficient to meet the state regulations. Accordingly, more vegetation sampling was conducted in 1994-1996 by K.A. Crofts to supplement the early vegetation data; these data can be found in an appendix in Willow Creek Mine's MRP called "*Supplemental Tables of Vegetation Sampling Data: 1994-1996*".

Sample Areas

The terminology used in the MRP for specific sample areas and the methodology criteria applied

to sample them have been described below. The following information also drove the sample design and plans made to monitor the reclaimed areas for this report.

1. **Disturbed Areas** - This refers to those areas where the plant communities were disturbed pre-SMCRA and were later re-disturbed post-SMCRA by coal mining activities. Because of this, they are regulated differently and have different revegetation success standard for final reclamation than those areas that were not re-disturbed after the Act. Both types of areas at the Willow Creek Mine site, pre-SMCRA and post-SMCRA, have now been reclaimed under appropriate state and federal regulations. The reclaimed *Disturbed Areas* were sampled to provide the 'supplemental data' (1994-96) mentioned above and were again sampled in 2008 using the same methodologies for this report. The Disturbed Areas include the following sites:
 - a. Gravel Canyon
 - b. Refuse Pile
 - c. Conveyor Corridor
2. **Reclaimed Areas** - These *Reclaimed Areas* were those areas that were disturbed pre-SMCRA and not re-disturbed by more current mining activities. These areas were later reclaimed by the AML program and are therefore not subject to the monitoring program required by Plateau Mining Corporation. Accordingly, these areas were not required to be sampled for this 2008 monitoring report.
3. **Riparian Bottoms** - This area was first sampled in 1994 to expand on the 'supplemental data' needed. They did not have the pre-SMCRA designation. Sample methods were different than those used for the *Disturbed Areas* above (more information about this will be described in the METHODS section of this report).
4. **Crandall Canyon** - Crandall Canyon, an area also associated with the Willow Creek Mine, is located on the west side of Price Canyon rather than the east side where the other reclaimed areas are located (see Willow Creek Mine Locator Map included with this report). Revegetation standards and sampling methods are yet again different than the above-mentioned areas. Again, more details about the methodologies employed will be provided later in this report.
5. **Reference Areas** - Based on the methods employed to monitor revegetation

success and the standards that were pre-determined by representatives from the past mine operators and officials from DOGM, *Reference Areas* may or may not be used to determine adequate revegetation success at the Willow Creek Mine. Or, in other words, Reference Areas are used as success standards for some of the reclaimed areas, whereas, they are not used in other areas.

Reference Areas are those areas that were chosen earlier to be sampled at the time of final reclamation. Data from the Reference Areas and specific areas that have been reclaimed are to be compared statistically to determine whether or not successful revegetation has been achieved at the time of *Final* or Phase III Bond Release. The "Reference Area Method" has been described in DOGMs *Vegetation Information Guidelines* (1992).

The Reference Areas sampled in association with the Willow Creek Mine's monitoring plan were:

- a. Mountain Brush (MB) Reference Area
- b. Crandall Canyon (SB) Reference Area

The above sample areas have been described in Willow Creek's MRP. Their locations can be found on several maps provided in that document.

METHODS

Methodologies used for sampling were performed in accordance with the aforementioned guidelines provided by DOGM. For reasons described above, and depending on the sample area, there has been an assortment of methods that have been employed to sample the vegetation at the Willow Creek Mine site. We have attempted to employ sampling methods that have appropriate scientific merit and comply with all state and federal regulations and guidelines, as well as remain consistent with previous sampling methods to make the previous and current datasets comparable to each other.

Transect and Quadrat Placement

Random/regular placement of sample quadrats were designed as an attempt to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines along the entire length of each reclaimed area. At regular intervals along the transect lines, random numbers were generated and used to measure distances at right angles from the line to determine sample locations. Whether these random numbers were odd or even determined which side of transect line a given quadrat was placed. The random numbers selected were high enough to place quadrats to the lateral limits of each sample area and all areas in-between. This insured that the sample quadrats were placed randomly over the entire study area in an attempt to adequately address and represent each site as a whole.

Cover, Frequency and Composition

Depending on the sample area and the history of sampling it, cover estimates were made by employing two different methods. In some areas ocular methods with meter square quadrats were used; other areas employed the point-intercept method using an inclined metal 10-point frame. Species composition and relative frequencies were also assessed from the cover data. Plant nomenclature follows "A Utah Flora" (Welsh et al. 2003).

Density

Similar to the reasons for employing different sample methods for cover, woody species density measurements also varied depending on the area. These methods were dictated by either community type, previous sampling history, or commitments about methods that were stated in the MRP. In some areas woody plant numbers were measured using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual. In other areas densities were measured using 1.5 M x 50.0 M belt transects. Here, all woody plants were counted inside the belts; the counts were then summarized and converted into the number of individual woody plants per acre.

Biomass Production

Total annual biomass production was estimated by clipping, drying and weighing current annual growth in each sample quadrat. "Double sampling" methods were employed by placing four additional quadrats around the clipped quadrat, then estimating the production of them relative to the clipped plot. Herbaceous and woody species production were recorded separately, then combined to provide the total production estimate.

Sample Size & Adequacy

Sampling adequacy was calculated using formula given below.

$$nMIN = \frac{t^2 s^2}{(dx)^2}$$

where,

<i>nMIN</i>	= minimum adequate sample
<i>t</i>	= appropriate confidence t-value
<i>s</i>	= standard deviation
<i>x</i>	= sample mean
<i>d</i>	= desired change from mean

However, sample size was often more a function of the size of each sample area within the reclaimed types, or more samples taken in larger areas compared to smaller ones. When final vegetation sampling is conducted for bond release at the end of the mine owner's "Responsibility Period", similar areas will be sample separately but later treated as a whole because the reclaimed plant communities should be quite similar. For example, the data from Gravel Canyon, the Conveyor Corridor and the Refuse Pile will probably be "lumped" at that time because they have all been seeded with the same species mixture and will result in the same community type (with some variations of course, as do the natural or undisturbed native plant communities nearby). Although these areas were sampled and reported separately here to determine whether or not there are "problem areas", ultimately the datasets will be combined. We used the acreage of these three reclaimed areas – Gravel Canyon (5.75 acres), the Conveyor Corridor (29.90 acres) and the Refuse Pile (46.76 acres), then used a "weighted" method to determine sample sizes. In summary, sample sizes were determined by considering the sample adequacy formula as well as

the size of the sample area itself. Sample sizes such as the Riparian Bottoms and Crandall Canyon were determined independent of all other areas.

Photographs

Color photographs of the sample areas were taken at the time of sampling and a subset of them have been submitted with this report.

Success Standards

The sampling history above describes some of the reasons that certain methodologies were employed in specific sample areas at the Willow Creek Mine site. Often the methods to be used to monitor a given parameter were dictated by the DOGM protocol that was chosen by representatives from the past mine operators and officials from DOGM. In some areas, the “**Reference Area**” protocol as described in DOGMs *Vegetation Information Guidelines* was employed. In other areas, the “**Baseline Information**” protocol was employed (also refer to *History of Vegetation Sampling* above for more discussion about this).

Summary of Sampling Methods

Table 1 below lists the protocols, sampling methods employed, and sample sizes for cover,

woody species density and productivity of each sample site at the Willow Creek Mine site.

TABLE 1: Summary of Vegetation Sample Areas, Protocols, Methods and sample sizes

SAMPLE AREA	PROTOCOL	COVER (sample size)	DENSITY (sample size)	PRODUCTIVITY (sample size)
Gravel Canyon	Baseline	Point-intercept (n=10)	Belt transects (n=2)	Clipped/Wt. (n=5)
Conveyor Corridor	Baseline	Point-intercept (n=50)	Belt transects (n=10)	Clipped/Wt. (n=25)
Refuse Pile	Baseline	Point-intercept (n=75)	Belt transects (n=15)	Clipped/Wt. (n=40)
Riparian Bottomlands	Baseline	Ocular (n=30)	Point-quarter (n=30)	n/a
Crandall Canyon Reclaimed Sagebrush	Reference Area	Ocular (n=80)	Point-quarter (n=80)	n/a
Crandall Canyon (East) Reclaimed Mtn. Brush	Reference Area	Ocular (n=15)	Point-quarter (n=15)	n/a
Crandall Canyon (West) Reclaimed Mtn. Brush	Reference Area	Ocular (n=15)	Point-quarter (n=15)	n/a
Mtn. Brush (MB) Reference Area	Reference Area	Ocular (n=20)	Point-quarter (n=20)	n/a
Crandall Canyon Reference Area	Reference Area	Ocular (n=40)	Point-quarter (n=40)	n/a

RESULTS

Gravel Canyon

Quantitative sampling the vegetation at the reclaimed Gravel Canyon site in 2008 revealed that the area was dominated by fourwing saltbush (*Atriplex canescens*), thickspike wheatgrass (*Elymus lanceolatus*), and yarrow (*Achillea millefolium*). For a list of all plant species present in

sample quadrats along with their cover and frequency values, refer to Table 2.

The total living cover of this reclaimed site was estimated at 53.00% (Table 3-A). Of that living cover, shrubs comprised 30.00% of it, grasses 40.95% and forbs 29.05% (Table 3-B). The total woody species density was estimated at 1,835 individuals per acre and was dominated by sagebrush (*Artemisia tridentata*) and fourwing saltbush (Table 4). Total annual biomass production of the site was estimated to be 1,887.46 pounds per acre, with 623.56 pounds coming from herbaceous species and 1,263.90 pounds from woody plants (Table 5).

Conveyor Corridor

The reclaimed Conveyor Corridor was dominated by thickspike wheatgrass, bluebunch wheatgrass (*Elymus spicatus*) and fourwing saltbush. For a list of the plant species present in sample quadrats along with their cover and frequency values, refer to Table 6.

The total living cover for this reclaimed site was estimated to be 43.60% (Table 7-A). The composition of the cover by lifeform was 59.30% grasses, 18.40% forbs and 22.30% shrubs (Table 7-B). Table 8 shows the woody species density in this area consisted of 1,165 individuals per acre with the dominants for this parameter consisting of fourwing saltbush, sagebrush, and rubber rabbitbrush (*Chrysothamnus nauseosus*). Productivity for the site was estimated at 1,569.50 pounds per acre with 573.76 pounds coming from herbaceous and 995.74 pounds from woody species (Table 9).

Refuse Pile

Quantitative sampling the vegetation at the reclaimed Refuse pile showed that the area was dominated by fourwing saltbush, thickspike wheatgrass and Palmer penstemon (*Penstemon palmeri*). For a list of all plant species present in sample quadrats along with their cover and frequency values, refer to Table 10.

The total living cover of this reclaimed site was estimated at 45.87% (Table 11-A). In that living cover, shrubs comprised 24.58%, grasses 51.09% and forbs 24.33% (Table 11-B). The total woody species density was estimated at 1,691 individuals per acre and was dominated by fourwing saltbush (Table 12). Total annual biomass production of the site was estimated to be 709.42 pounds per acre, with 349.05 pounds coming from herbaceous species and 360.37 pounds from woody plants (Table 13).

Riparian Bottoms

The reclaimed Riparian Bottoms were greatly dominated by coyote willow (*Salix exigua*). For a list of the plant species present in sample quadrats along with their cover and frequency values, refer to Table 14.

The total living cover (overstory and understory cover combined) for this reclaimed site was estimated to be 71.33% (Table 15-A). The composition of the understory cover by lifeform was

3.00% grasses, 2.33% forbs and 94.67% shrubs (Table 15-B). Table 16 shows the woody species density in this area consisted of 4,168 individuals per acre with the dominants here consisting of coyote willow, Wood's rose (*Rosa woodsii*) and golden current (*Ribes aureum*). Productivity measurements were not required in 2008 for this area

Crandall Canyon Sagebrush Areas

Cover by plant species for these reclaimed areas, the Sagebrush Areas in Crandall Canyon, are shown in Table 17. These results indicated that the area was dominated by big sagebrush, Lewis' flax (*Linum lewisii*), and western wheatgrass (*Elymus smithii*).

The total living cover of the reclaimed site was estimated at 50.00% (Table 18-A). In that living cover, shrubs comprised 26.34%, grasses 42.12% and forbs 31.55% (Table 18-B). The total woody species density was estimated at 6,874 individuals per acre and was dominated by fourwing saltbush (Table 19).

Crandall Canyon Mtn. Brush Areas (East)

Two different areas were reclaimed as the Mountain Brush community type in Crandall Canyon. They were sampled separately to identify any differences or "problem areas" at each site. Consequently, the data were also reported separately in this report.

Quantitative sampling the reclaimed Mtn. Brush (East) site in Crandall Canyon revealed that the area was dominated by Gt. Basin wildrye (*Elymus cinereus*) and big sagebrush (Table 20).

The total living cover of this reclaimed community was estimated at 58.33% (Table 21-A). Of the living cover, the composition was comprised of shrubs at 19.47%, grasses were 64.59% and forbs were 15.94% (Table 21-B). The total woody species density was estimated at 3,359 individuals per acre and was dominated by sagebrush (Table 22).

Crandall Canyon Mtn. Brush Areas (West)

The other reclaimed Mountain Brush site that was sampled in Crandall Canyon was located west of the first site. Quantitative sampling the this site suggested that the area was dominated by similar species as the east site, Salina wildrye and big sagebrush, but there were other species that had values that were very close to these two species such as thickspike wheatgrass, western wheatgrass and Indian ricegrass (*Stipa hymenoides*). For a list of all plant species present in sample quadrats along with their cover and frequency values, refer to Table 23.

The total living cover of this reclaimed site was estimated at 49.67% (Table 24-A). Of that living cover, shrubs represented 16.94% of it, whereas grasses and forbs were represented at 54.51% and 28.55%, respectively (Table 24-B). The total woody species density was estimated at 5,706 individuals per acre and was dominated by big sagebrush and black sagebrush (*Artemisia nova*). Results from woody species density measurements can be found on Table 25.

Crandall Canyon Mtn. Brush (MB) Reference Area

When DOGMs "Reference Area" protocol was employed, the reclaimed areas are to be compared to communities that have been chosen to represent standards for final revegetation success with the areas that were disturbed and reclaimed by mining operations. The reference area to be compared to the reclaimed Mtn. Brush communities in Crandall Canyon was called the Mountain Brush (MB) Reference Area. This reference area, however, is located near the old Conveyor Corridor and some of the surface facilities of the Willow Creek Mine on the east side of Price Canyon rather than the west side where Crandall Canyon is located.

Cover and frequency by plant species for this reference area is shown in Table 26. Sampling results in this area indicated that it was dominated by Salina wildrye by quite a wide margin, but followed by big sagebrush and Indian ricegrass. The tree and shrub species present in this community, probably the reason for labeling it a "Mtn. Brush Reference Area", were Utah Juniper (*Juniperus osteosperma*), pinyon-pine (*Pinus edulis*) and Utah serviceberry (*Amelanchier utahensis*).

The total living cover (including overstory and understory cover combined) of this reference area was estimated at 36.25% (Table 27-A). In that living cover, shrubs comprised 32.55%, grasses 64.78% and forbs 2.67% (Table 27-B). The total woody species density was estimated at 2,488 individuals per acre and was dominated by big sagebrush, Utah serviceberry, broom snakeweed (*Gutierrezia sarothrae*) and Utah juniper (Table 28).

Crandall Canyon (SB) Reference Area

The reference area to be compared to the Reclaimed Sagebrush communities in Crandall Canyon was called the Crandall Canyon Reference Area. Like the above reference area, this reference area is located at the Willow Creek Mine on the east side of Price Canyon rather than the west side where Crandall Canyon is located. The locations of the two reference areas, the Crandall Canyon Mtn. Brush (MB) Reference Area and the Crandall Canyon (SB) Reference Area, are shown on maps in the Willow Creek Mine MRP, but a general locator map of the permit area including Crandall Canyon that was prepared by DOGM has been included with this report.

Cover and frequency by plant species for this reference area are shown in Table 29. Similar to the aforementioned reference area, sampling results in the area show that this reference area was dominated by Salina wildrye by quite a wide margin, but followed by big sagebrush. However, the remaining species present in the quadrats were less similar than the other reference area.

The total living cover of this reference area was estimated at 37.88% (Table 30-A). In that living cover, shrubs comprised 27.45%, grasses 63.75% and forbs 8.79% (Table 30-B). The total woody species density was estimated at 857 individuals per acre and was dominated by big sagebrush, Utah serviceberry, broom snakeweed (*Gutierrezia sarothrae*) and fourwing saltbrush (Table 31).

DISCUSSION

Willow Creek Mine Disturbed Areas

The so-called “Disturbed Areas” at the Willow Creek Mine site are comprised of reclaimed areas including: 1) Gravel Canyon, 2) the Conveyor Corridor and 3) the Refuse Pile. The reclaimed Riparian Bottoms have also been included in the Willow Creek monitoring regime. Because the protocol for revegetation success standards here employed the *Baseline Method*, comparisons were made between revegetation success standards [or baseline datasets (1994-96)] and current datasets (2008). Fig. 1 illustrates that the **total living cover** values of the current dataset were greater than that of the baseline data. The **woody species density** values of the these same areas were also greater in the current dataset when compared to the baseline standards (Fig. 2).

Finally, annual biomass production of the Disturbed Areas were also compared graphically (Fig. 3). The current productivity estimates greatly exceeded those shown in the baseline dataset.

Crandall Canyon Areas

The reclaimed areas in Crandall Canyon consisted of: 1) Sagebrush Areas, 2) Mtn. Brush Areas (East), and 3) Mtn. Brush Areas (West). The protocol to measure revegetation success in these areas employed the “Reference Area” method. This method uses pre-determined reference areas, or undisturbed plant communities chosen to represent future revegetation success standards.

Two reference areas were chosen to be compared with the reclaimed areas of Crandall Canyon including: 1) the Mountain Brush (MB) Reference Area and 2) the Crandall Canyon (SB) Reference Area. Graphic illustrations comparing the **total living cover** of the reclaimed areas in Crandall Canyon with their respective reference areas show that the reclaimed areas have exceeded their standard for revegetation success (Fig. 4). Furthermore, **woody species density** values of the reclaimed sites in Crandall Canyon also far exceeded those of the reference area (Fig. 5). Annual biomass production was not needed for this sample period when the Reference Area method is employed. This parameter will be measured at the end of the Responsibility Period prior to Phase III or Final Bond Release applications are submitted.

SUMMARY & CONCLUSIONS

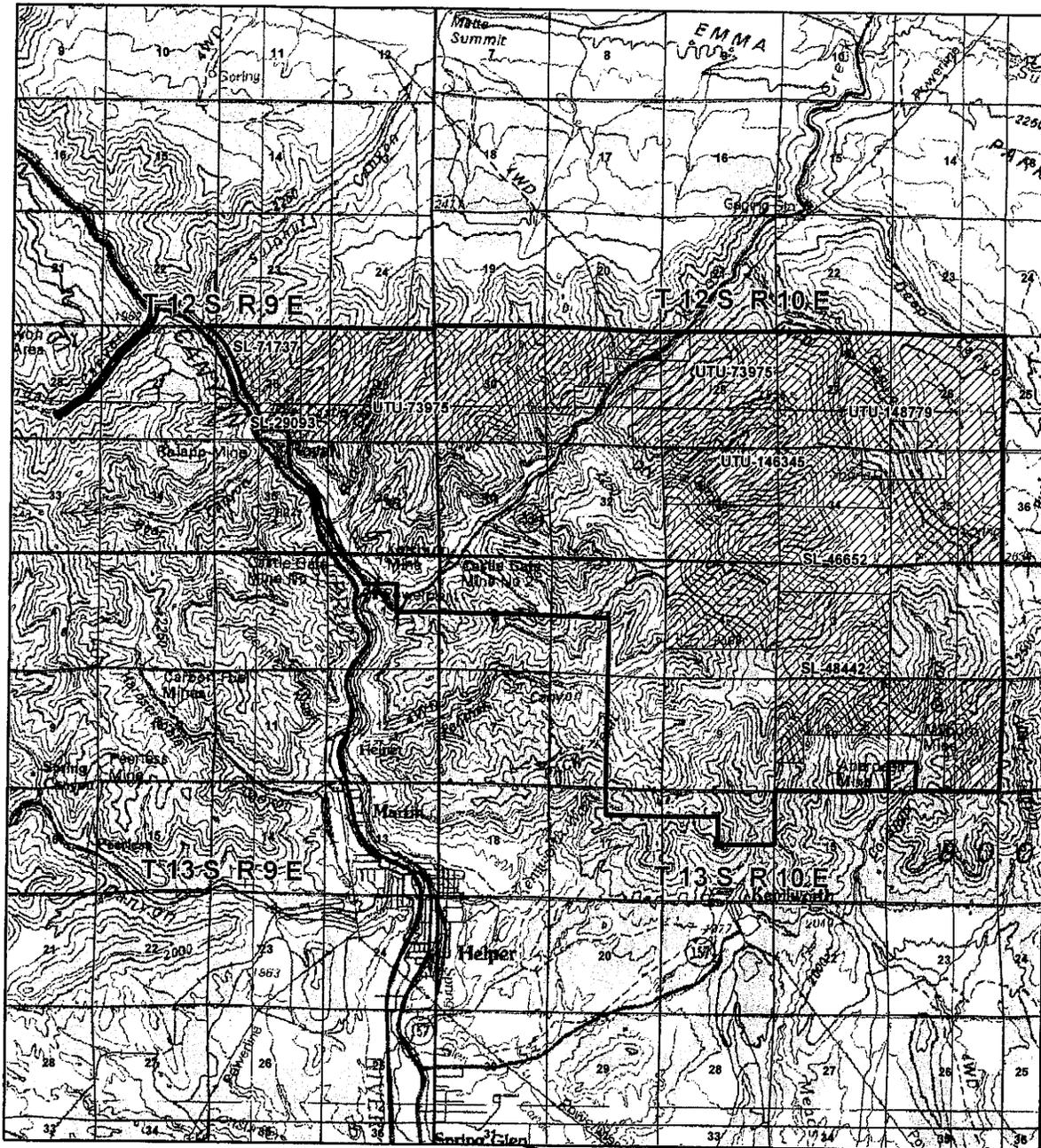
Plant communities disturbed by mining operations at the Willow Creek Mine site have been reclaimed for four years now. These areas were sampled in 2008 to provide Year 4 data for comparisons with the revegetation success standards, the standards that will ultimately be used to determine whether or not final bond release is warranted and the end of the owner's Responsibility Period.

Depending on the specific reclaimed area and the protocol required to determine revegetation success standards (Baseline Method or Reference Area Method) the following parameters were compared: 1) total living cover, 2) woody species density and 3) annual biomass productivity. In

all cases, the reclaimed areas met or exceeded those of the success standards.

Although the parameters mentioned above are the principal values used to determine revegetation success, other indicators can also be used from the datasets. For example, species diversity, cover and frequency values, presence of “desirable” plant species versus “weedy” or exotic species, and species composition can be compared between the reclaimed areas and their respective success standards. In all instances, the reclaimed areas appear to be progressing very well to becoming communities that are “diverse, effective and permanent” as required by state regulations for land once disturbed by coal mining operations.

WILLOW CREEK MINE LOCATOR MAP



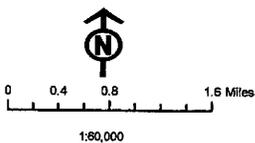
Willow Creek Mine

C0070038
Carbon County, Utah
January 2006

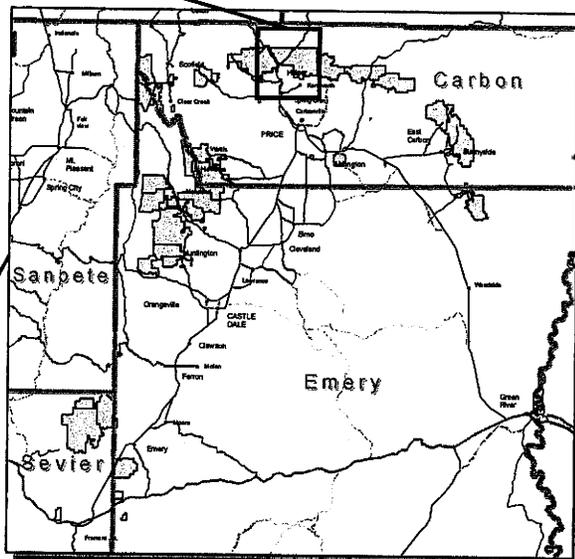
Township 12 South Range 9 & 10 East
Township 13 South Range 9 & 10 East

File: N:\gis\coal\coalareamaps\C0070038.pdf

-  Permit Area
-  Proposed Mine Plan Modification (if shown)
-  Federal Lease Areas



 State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining



Locator Map

DATA SUMMARY TABLES

Table 2: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2008).

Gravel Canyon			
			n=10
TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
<i>Atriplex canescens</i>	19.00	29.82	30.00
FORBS			
<i>Achillea millefolium</i>	9.00	15.78	30.00
<i>Machaeranthera canescens</i>	2.00	6.00	10.00
<i>Penstemon palmeri</i>	2.00	6.00	10.00
GRASSES			
<i>Elymus lanceolatus</i>	14.00	18.00	30.00
<i>Elymus smithii</i>	2.00	6.00	10.00
<i>Elymus spicatus</i>	4.00	12.00	10.00
<i>Stipa hymenoides</i>	1.00	3.00	10.00

Table 3: Willow Creek Mine Area. Total Cover and Composition (2008).

Gravel Canyon		
		n=10
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	53.00	15.52
Litter	15.00	12.04
Bareground	13.00	11.87
Rock	19.00	13.00
B. % COMPOSITION		
Shrubs	30.00	45.83
Forbs	29.05	35.69
Grasses	40.95	40.39

Table 4: Willow Creek Mine Area. Woody Species Density (2008).

Gravel Canyon n=2

SPECIES	Individuals Per Acre
<i>Artemisia tridentata</i>	593.53
<i>Atriplex canescens</i>	1187.07
<i>Ceratoides lanata</i>	53.96
TOTAL	1834.56

Table 5: Willow Creek Mine Area. Annual Production (2008).

Gravel Canyon n=5

LIFEFORM	Pounds/Acre	
	Mean.	Std. Dev.
Herbaceous	623.56	249.09
Woody	1263.90	655.38
TOTAL	1887.46	680.65

Table 6: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2008).

Conveyor Corridor (Reclaimed)			
	Mean	Standard	n=50
TREES & SHRUBS	Percent	Deviation	Percent Frequency
<i>Atriplex canescens</i>	9.20	19.68	22.00
<i>Artemisia tridentata</i>	0.20	1.40	2.00
<i>Chrysothamnus nauseosus</i>	2.40	9.71	6.00
FORBS			
<i>Achillea millefolium</i>	0.80	2.71	8.00
<i>Halogeton glomeratus</i>	0.40	2.80	2.00
<i>Linum lewisii</i>	2.40	8.14	10.00
<i>Machaeranthera canescens</i>	0.40	2.80	2.00
<i>Penstemon palmeri</i>	2.00	6.63	10.00
<i>Salsola tragus</i>	1.20	5.88	4.00
GRASSES			
<i>Bromus tectorum</i>	0.60	3.10	4.00
<i>Elymus lanceolatus</i>	10.40	15.49	38.00
<i>Elymus smithii</i>	0.40	2.80	2.00
<i>Elymus spicatus</i>	9.80	17.49	30.00
<i>Stipa hymenoides</i>	3.40	8.86	16.00

Table 7: Willow Creek Mine Area. Total Cover and Composition (2008).

Conveyor Corridor (Reclaimed)		
		n=50
A. TOTAL COVER		
	Mean Percent	Standard Deviation
Total Living Cover	43.60	13.82
Litter	16.20	15.48
Bareground	13.60	11.45
Rock	26.60	17.84
B. % COMPOSITION		
Shrubs	22.30	36.89
Forbs	18.40	34.81
Grasses	59.30	42.68

Table 8: Willow Creek Mine Area. Woody Species Density (2008).

Conveyor Corridor (Reclaimed)		n=10
SPECIES		Individuals Per Acre
<i>Artemisia tridentata</i>		151.08
<i>Atriplex canescens</i>		766.20
<i>Ceratoides lanata</i>		37.77
<i>Cercocarpus ledifolius</i>		5.40
<i>Chrysothamnus nauseosus</i>		205.04
TOTAL		1165.48

Table 9: Willow Creek Mine Area. Annual Production (2008).

Conveyor Corridor (Reclaimed)		
		n=25
LIFEFORM	Pounds/Acre	
	Mean	Std. Dev.
Herbaceous	573.76	426.87
Woody	995.74	936.29
TOTAL	1569.50	823.67

Table 10: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2008).

Refuse Pile (Reclaimed)			
	Mean	Standard	n=75
TREES & SHRUBS	Percent	Deviation	Percent Frequency
<i>Atriplex canescens</i>	13.87	24.92	30.67
<i>Artemisia tridentata</i>	0.53	3.22	2.67
<i>Chrysothamnus nauseosus</i>	0.27	2.29	1.33
FORBS			
<i>Achillea millefolium</i>	0.27	2.29	1.33
<i>Penstemon palmeri</i>	5.20	12.15	21.33
<i>Linum lewisii</i>	3.33	8.38	14.67
<i>Halogeton glomeratus</i>	0.53	3.22	2.67
<i>Melilotus officinalis</i>	0.40	3.44	1.33
GRASSES			
<i>Elymus smithii</i>	1.47	7.06	5.33
<i>Elymus spicatus</i>	3.47	9.59	14.67
<i>Elymus lanceolatus</i>	12.67	15.86	49.33
<i>Stipa hymenoides</i>	1.47	5.82	6.67
<i>Elymus cinereus</i>	1.47	7.95	4.00
<i>Bromus carinatus</i>	0.93	5.21	4.00

Table 11: Willow Creek Mine Area. Total Cover and Composition (2008).

Refuse Pile (Reclaimed)		n=75
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	45.87	16.90
Litter	14.13	15.15
Bareground	14.80	13.60
Rock	25.20	17.92
B. % COMPOSITION		
Shrubs	24.58	39.61
Forbs	24.33	36.04
Grasses	51.09	42.81

Table 12: Willow Creek Mine Area. Woody Species Density (2008).

Refuse Pile (Reclaimed)		n=15
SPECIES	Individuals	Per Acre
<i>Artemisia tridentata</i>		39.57
<i>Atriplex canescens</i>		1557.58
<i>Ceratoides lanata</i>		17.99
<i>Chrysothamnus nauseosus</i>		75.54
TOTAL		1690.67

Table 13: Willow Creek Mine Area. Annual Production (2008).

Refuse Pile (Reclaimed)		n=40
LIFEFORM	Pounds/Acre	
	Mean	Std. Dev.
Herbaceous	349.05	229.77
Woody	360.37	359.30
TOTAL	709.42	280.19

Table 14: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2008).

Riparian Bottoms (Reclaimed)			
	Mean	Standard	n=30
OVERSTORY	Percent	Deviation	Percent
TREES & SHRUBS			Frequency
<i>Salix exigua</i>	12.33	19.35	33.33
UNDERSTORY			
TREES & SHRUBS			
<i>Artemisia tridentata</i>	0.33	1.25	6.67
<i>Atriplex canescens</i>	0.17	0.90	3.33
<i>Chrysothamnus nauseosus</i>	1.17	4.78	6.67
<i>Populus fremontii</i>	1.67	8.98	3.33
<i>Ribes aureum</i>	5.83	12.18	20.00
<i>Rosa woodsii</i>	6.17	14.24	20.00
<i>Salix exigua</i>	41.17	28.39	83.33
FORBS			
<i>Melilotus officinale</i>	0.33	1.80	3.33
<i>Penstemon palmeri</i>	0.83	3.67	6.67
GRASSES			
<i>Elymus elymoides</i>	0.33	1.80	3.33
<i>Elymus lanceolatus</i>	0.67	2.13	10.00
<i>Elymus spicatus</i>	0.33	1.80	3.33

Riparian Bottoms (Reclaimed)		n=30
A. TOTAL COVER	Mean Percent	Standard Deviation
Overstory (o)	12.33	19.35
Understory (u)	59.00	18.18
Litter	9.00	7.43
Bareground	14.07	12.19
Rock	17.93	14.40
o+u	71.33	23.31
B. % COMPOSITION		
Shrubs	94.67	18.46
Forbs	2.33	10.86
Grasses	3.00	8.76

Table 16: Willow Creek Mine Area. Woody Species Density (2008).

Riparian Bottoms (Reclaimed)	n=30
SPECIES	Individuals Per Acre
<i>Artemisia tridentata</i>	138.92
<i>Atriplex canescens</i>	69.46
<i>Chrysothamnus nauseosus</i>	243.11
<i>Populus fremontii</i>	34.73
<i>Prunus virginiana</i>	34.73
<i>Ribes aureum</i>	729.32
<i>Rosa woodsii</i>	729.32
<i>Salix exigua</i>	2187.95
TOTAL	4167.53

Table 17: Crandall Canyon Area. Living Cover and Frequency by Plant Species (2008).

Sagebrush/Grass (Reclaimed)				n=80
TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency	
<i>Artemisia nova</i>	0.94	4.68	5.00	
<i>Artemisia tridentata</i>	10.85	8.82	76.25	
<i>Cercocarpus ledifolius</i>	1.10	3.51	12.50	
<i>Chrysothamnus nauseosus</i>	0.50	3.22	2.50	
FORBS				
<i>Achillea millefolium</i>	0.19	0.95	3.75	
<i>Artemisia ludoviciana</i>	1.38	3.26	18.75	
<i>Aster chilensis</i>	1.25	3.67	11.25	
<i>Linum lewisii</i>	7.05	7.24	67.50	
<i>Melilotus officinalis</i>	2.31	4.81	28.75	
<i>Penstemon palmeri</i>	0.06	0.56	1.25	
<i>Penstemon sp.</i>	2.31	4.61	26.25	
GRASSES				
<i>Bromus carinatus</i>	0.56	3.06	5.00	
<i>Elymus cinereus</i>	4.66	9.12	32.50	
<i>Elymus junceus</i>	0.88	5.69	2.50	
<i>Elymus lanceolatus</i>	4.35	7.95	37.50	
<i>Elymus smithii</i>	4.40	6.59	42.50	
<i>Elymus spicatus</i>	3.71	7.82	28.75	
<i>Poa secunda</i>	2.69	4.81	27.50	
<i>Stipa hymenoides</i>	0.81	4.36	5.00	

Table 18: Crandall Canyon Area. Total Cover and Composition (2008).		
Sagebrush/Grass (Reclaimed)		n=80
A. TOTAL COVER		
	Mean Percent	Standard Deviation
Total Living Cover	50.00	11.67
Litter	14.31	7.28
Bareground	11.81	5.71
Rock	23.88	12.07
B. % COMPOSITION		
Shrubs	26.34	18.53
Forbs	31.55	23.70
Grasses	42.12	25.01

**Table 19: Crandall Canyon Area.
Woody Species Density (2008).**

Sagebrush/Grass (Reclaimed)	n=80
SPECIES	Individuals Per Acre
<i>Artemisia nova</i>	601.43
<i>Artemisia tridentata</i>	5305.48
<i>Cercocarpus ledifolius</i>	859.19
<i>Chrysothamnus nauseosus</i>	64.44
<i>Gutierrezia sarothrae</i>	21.48
<i>Pinus edulis</i>	21.48
TOTAL	6873.50

Table 20: Crandall Canyon Area. Living Cover and Frequency by Plant Species (2008).

Mountain Brush - East (Reclaimed)			n=15
TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
<i>Artemisia tridentata</i>	10.00	10.17	60.00
<i>Cercocarpus ledifolius</i>	0.67	2.49	6.67
<i>Chrysothamnus nauseosus</i>	0.67	2.49	6.67
FORBS			
<i>Artemisia ludoviciana</i>	2.00	5.10	20.00
<i>Iva axillaris</i>	0.33	1.25	6.67
<i>Linum lewisii</i>	3.67	4.64	40.00
<i>Melilotus officinalis</i>	0.67	2.49	6.67
<i>Penstemon sp.</i>	1.67	3.94	20.00
GRASSES			
<i>Elymus cinereus</i>	20.67	22.28	80.00
<i>Elymus lanceolatus</i>	5.67	8.54	40.00
<i>Elymus smithii</i>	5.00	7.53	33.33
<i>Elymus spicatus</i>	5.33	8.06	33.33
<i>Poa secunda</i>	2.00	5.10	13.33

Table 21: Crandall Canyon Area. Total Cover and Composition (2008).		
Mountain Brush - East (Reclaimed)		n=15
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	58.33	10.75
Litter	18.33	7.89
Bareground	14.33	10.47
Rock	9.00	4.90
B. % COMPOSITION		
Shrubs	19.47	18.31
Forbs	15.94	19.01
Grasses	64.59	25.18

Table 22: Crandall Canyon Area. Woody Species Density (2008).

Mountain Brush - East (Reclaimed)		n=15
SPECIES	Individuals	Per Acre
<i>Artemisia tridentata</i>	3078.77	
<i>Cercocarpus ledifolius</i>	55.98	
<i>Chrysothamnus nauseosus</i>	223.91	
TOTAL	3358.66	

Table 23: Crandall Canyon Area. Living Cover and Frequency by Plant Species (2008).

Mountain Brush - West (Reclaimed)			n=15
TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
<i>Artemisia nova</i>	2.00	4.40	20.00
<i>Artemisia tridentata</i>	5.67	9.29	40.00
<i>Cercocarpus ledifolius</i>	1.20	3.08	13.33
FORBS			
<i>Artemisia ludoviciana</i>	0.67	1.70	13.33
<i>Aster chilensis</i>	2.00	5.10	20.00
<i>Linum lewisii</i>	4.00	6.11	40.00
<i>Machaeranthera canescens</i>	1.33	4.99	6.67
<i>Melilotus officinalis</i>	2.00	6.27	13.33
<i>Penstemon sp.</i>	3.33	4.71	40.00
GRASSES			
<i>Bromus carinatus</i>	0.33	1.25	6.67
<i>Elymus cinereus</i>	7.33	9.46	53.33
<i>Elymus lanceolatus</i>	5.47	8.27	46.67
<i>Elymus smithii</i>	5.00	6.83	46.67
<i>Elymus spicatus</i>	3.00	11.22	6.67
<i>Poa secunda</i>	2.33	6.55	13.33
<i>Stipa hymenoides</i>	4.00	9.35	20.00

Table 24: Crandall Canyon Area. Total Cover and Composition (2008).		
Mountain Brush - West (Reclaimed)		n=15
A. TOTAL COVER		
	Mean Percent	Standard Deviation
Total Living Cover	49.67	10.24
Litter	15.33	10.08
Bareground	11.67	8.69
Rock	23.33	11.79
B. % COMPOSITION		
Shrubs	16.94	19.81
Forbs	28.55	20.10
Grasses	54.51	22.82

**Table 25: Crandall Canyon Area.
Woody Species Density (2008).**

Mountain Brush - West (Reclaimed)		n=15
SPECIES		Individuals Per Acre
<i>Artemisia nova</i>		855.92
<i>Artemisia tridentata</i>		4279.61
<i>Cercocarpus ledifolius</i>		475.51
<i>Chrysothamnus nauseosus</i>		95.10
TOTAL		5706.15

Table 26: Crandall Canyon Mountain Brush (MB) Reference Area (located near Willow Creek Mine Area). Living Cover and Frequency by Plant Species (2008).

Mountain Brush (MB) Reference Area			
			n=20
OVERSTORY	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
<i>Juniperus osteosperma</i>	1.75	5.31	10.00
<i>Pinus edulis</i>	1.00	4.36	5.00
UNDERSTORY			
TREES & SHRUBS			
<i>Amelanchier utahensis</i>	0.50	2.18	5.00
<i>Artemisia nova</i>	0.50	2.18	5.00
<i>Artemisia tridentata</i>	6.50	7.26	50.00
<i>Atriplex canescens</i>	0.75	3.27	5.00
<i>Gutierrezia sarothrae</i>	1.25	3.49	15.00
<i>Juniperus osteosperma</i>	1.50	3.91	15.00
<i>Pinus edulis</i>	0.25	1.09	5.00
FORBS			
<i>Machaeranthera grindelioides</i>	0.75	2.38	10.00
GRASSES			
<i>Elymus salinus</i>	15.25	9.93	85.00
<i>Stipa hymenoides</i>	6.25	7.22	55.00

Table 27: Crandall Canyon Mountain Brush (MB) Reference Area (located near Willow Creek Mine Area). Total Cover and Composition (2008).

Mountain Brush (MB) Reference Area		n=20
A. TOTAL COVER		
	Mean Percent	Standard Deviation
Overstory (o)	2.75	6.61
Understory (u)	33.50	7.76
Litter	19.25	5.97
Bareground	17.00	11.11
Rock	30.25	10.78
o+u	36.25	6.68
B. % COMPOSITION		
Shrubs	32.55	23.56
Forbs	2.67	8.27
Grasses	64.78	22.13

Table 28: Crandall Canyon Mountain Brush (MB) Reference Area (located near Willow Creek Mine Area). Woody Species Density (2008).

Mountain Brush (MB) Reference Area		n=20
SPECIES	Individuals Per Acre	
<i>Amelanchier utahensis</i>	217.67	
<i>Artemisia tridentata</i>	1554.75	
<i>Artemisia nova</i>	186.57	
<i>Atriplex confertifolia</i>	31.10	
<i>Atriplex canescens</i>	31.10	
<i>Ephedra viridis</i>	31.10	
<i>Gutierrezia sarothrae</i>	186.57	
<i>Juniperus osteosperma</i>	186.57	
<i>Pinus edulis</i>	62.19	
TOTAL	2487.61	

Table 29: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2008)

Crandall Canyon (SB) Reference Area			n=40
TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
<i>Artemisia tridentata</i>	5.50	11.00	22.50
<i>Atriplex canescens</i>	3.13	9.47	12.50
<i>Atriplex confertifolia</i>	0.13	0.78	2.50
<i>Chrysothamnus nauseosus</i>	1.00	6.24	2.50
<i>Ephedra viridis</i>	0.75	4.68	2.50
FORBS			
<i>Artemisia ludoviciana</i>	3.13	8.04	20.00
<i>Machaeranthera grindelioides</i>	0.26	1.58	2.50
GRASSES			
<i>Bouteloua gracilis</i>	0.13	0.78	2.50
<i>Bromus tectorum</i>	1.75	4.12	20.00
<i>Elymus salinus</i>	20.38	15.71	75.00
<i>Stipa comata</i>	1.75	5.07	12.50

Table 30: Willow Creek Mine Area. Total Cover and Composition (2008)		
Crandall Canyon (SB) Reference Area		n=40
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	37.88	7.06
Litter	13.75	9.86
Bareground	8.25	5.43
Rock	40.13	13.11
B. % COMPOSITION		
Shrubs	27.45	38.01
Forbs	8.79	21.69
Grasses	63.75	38.66

**Table 31: Willow Creek Mine Area.
Woody Species Density (2008).**

Crandall Canyon (SB) Reference Area		n=40
SPECIES	Individuals Per Acre	
<i>Amelanchier utahensis</i>	5.36	
<i>Artemisia tridentata</i>	503.73	
<i>Atriplex confertifolia</i>	16.08	
<i>Atriplex canescens</i>	203.64	
<i>Chrysothamnus nauseosus</i>	21.44	
<i>Ephedra viridis</i>	48.23	
<i>Opuntia polyacantha</i>	53.59	
<i>Yucca harrimaniae</i>	5.36	
TOTAL	857.42	

FIGURES

Fig. 1: Total Living Cover
Willow Creek Reclaimed Areas

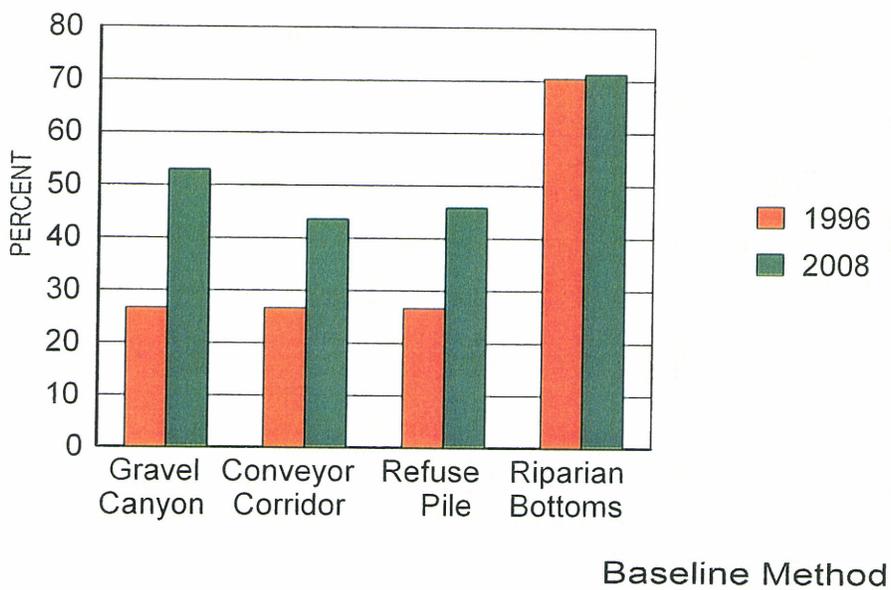
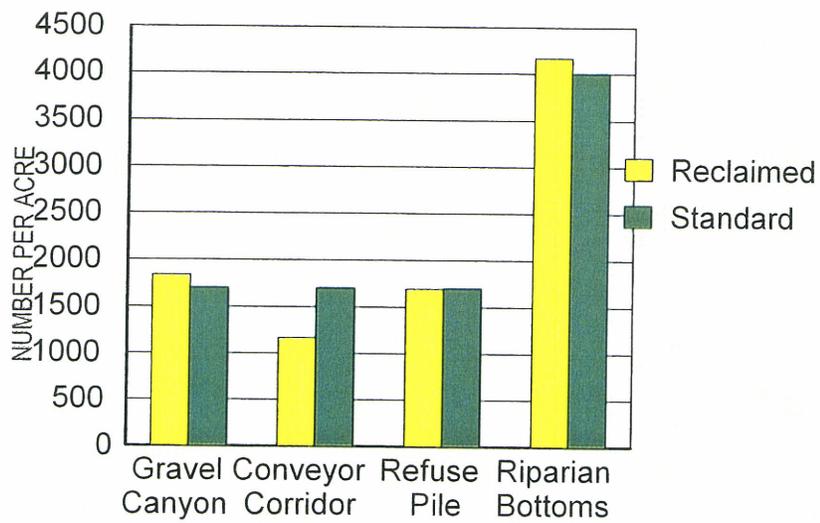
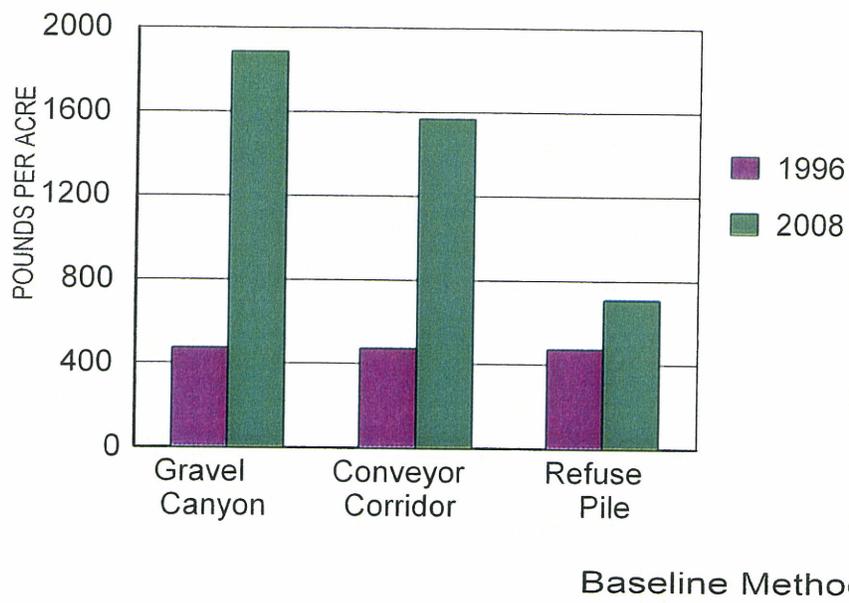


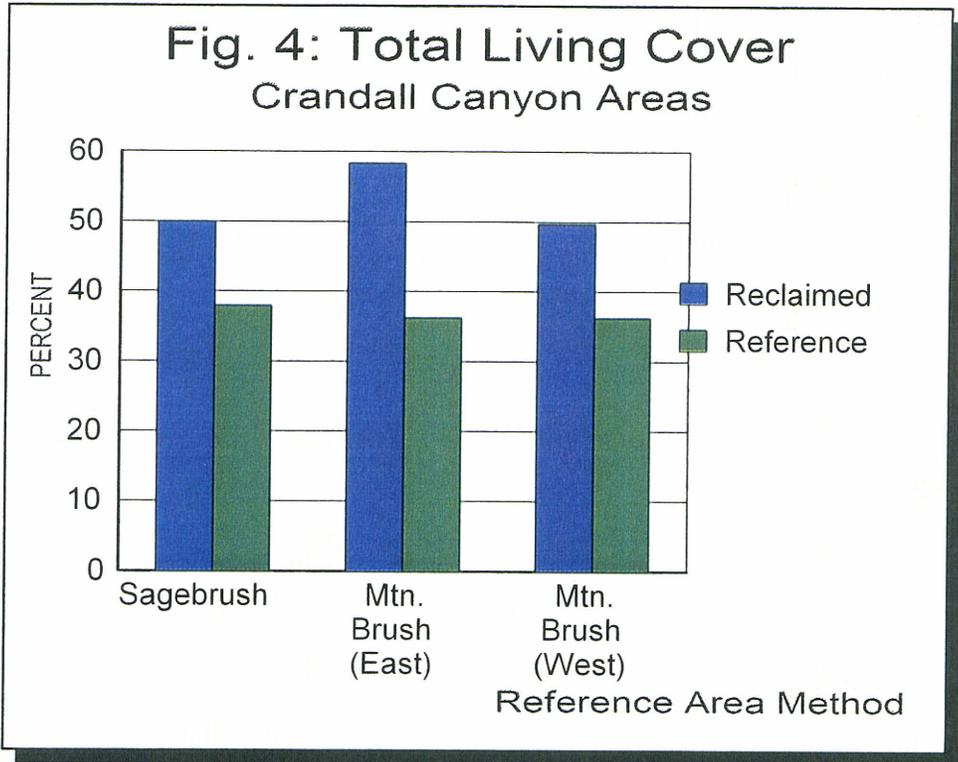
Fig. 2: Woody Species Density
Willow Creek Reclaimed Areas



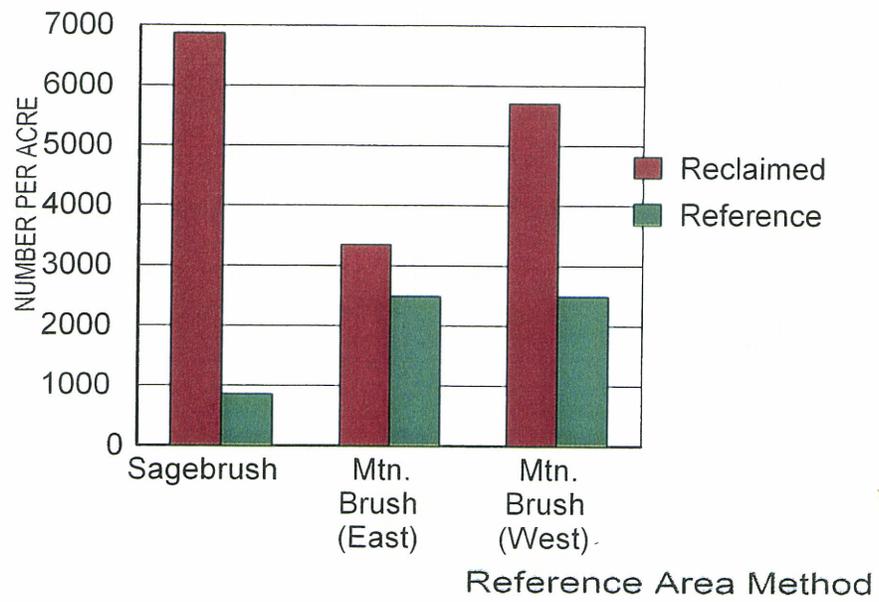
Baseline Method

Fig. 3: Biomass Production
Willow Creek Reclaimed Areas



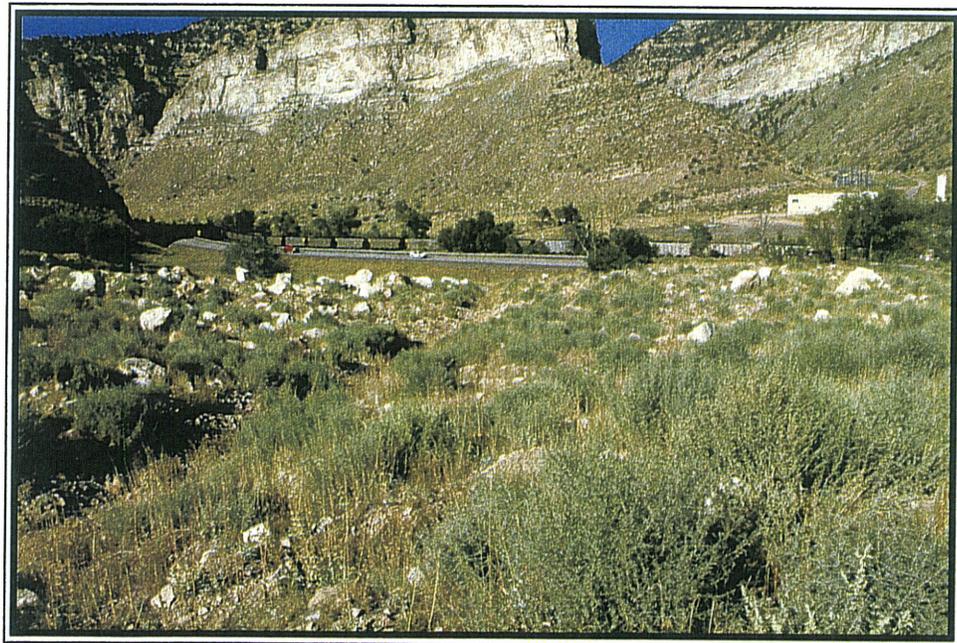
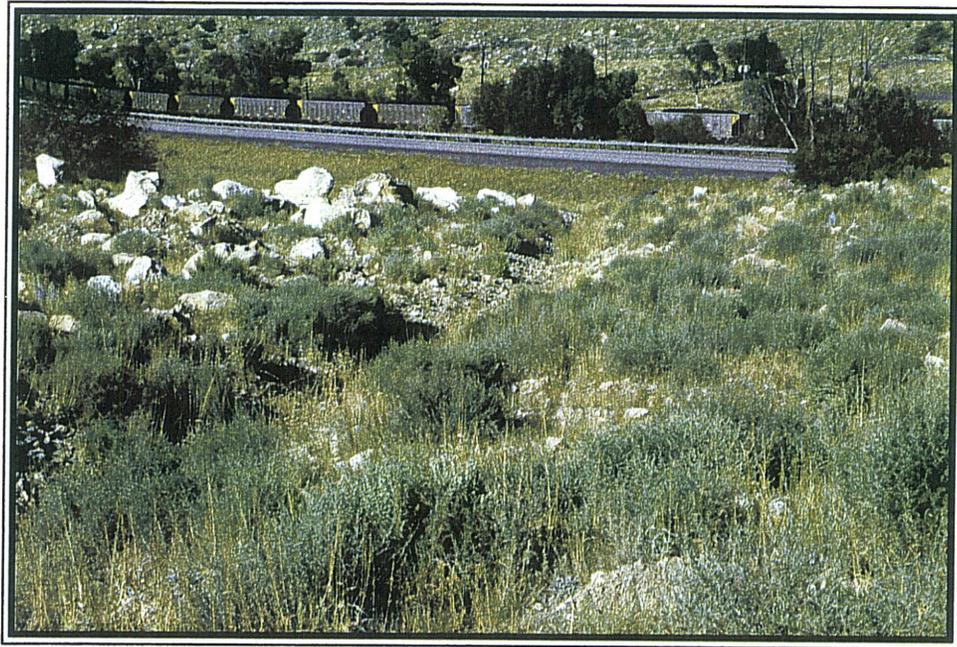


**Fig. 5: Woody Species Density
Crandall Canyon Areas**

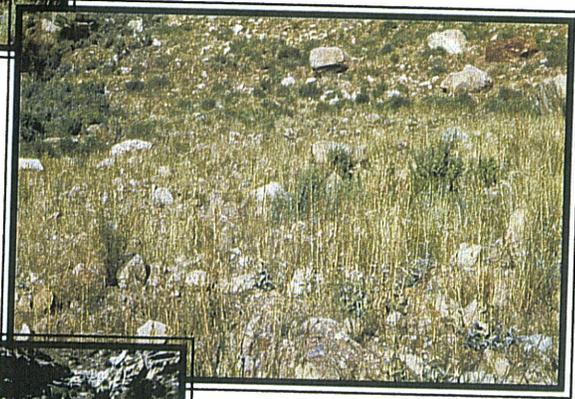


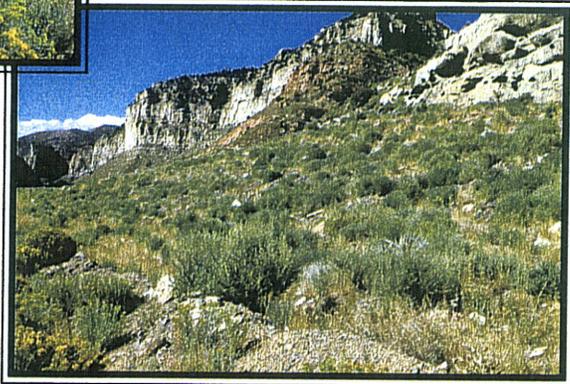
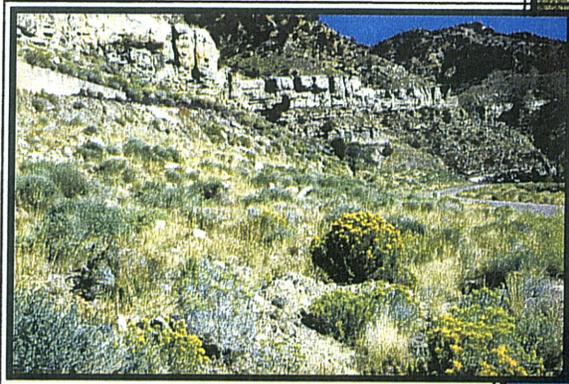
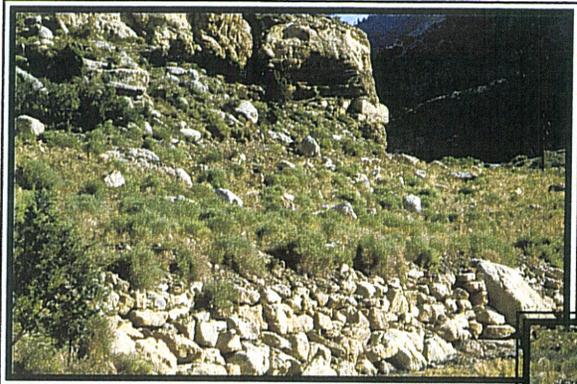
COLOR PHOTOGRAPHS
OF THE
SAMPLE AREAS

WILLOW CREEK RECLAIMED GRAVEL CANYON

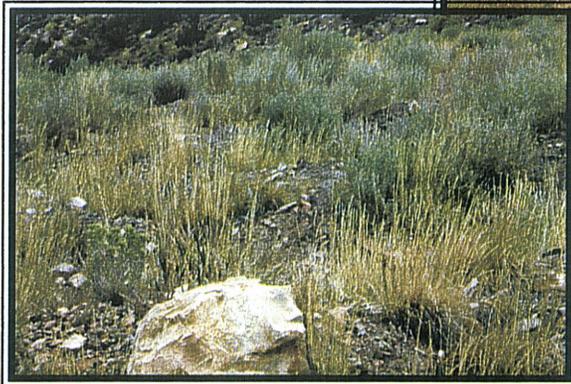
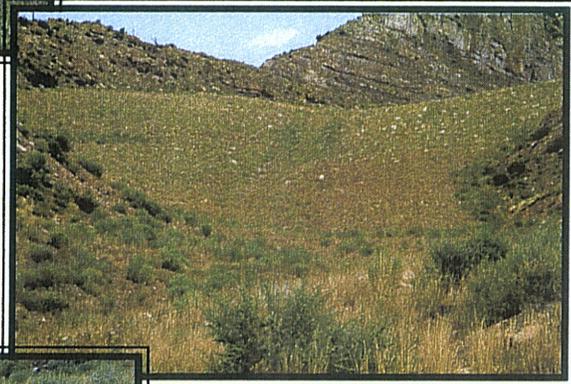


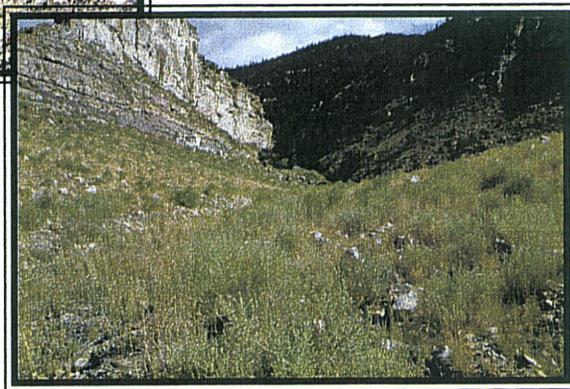
WILLOW CREEK RECLAIMED CONVEYOR CORRIDOR

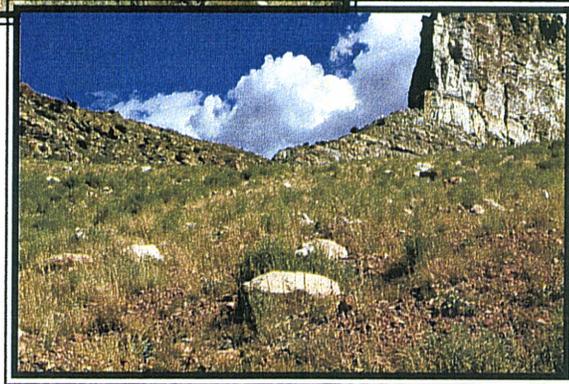
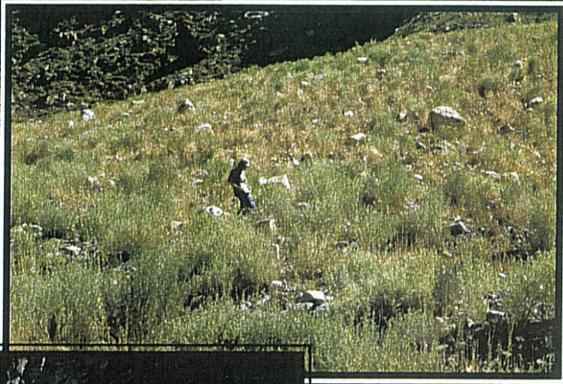
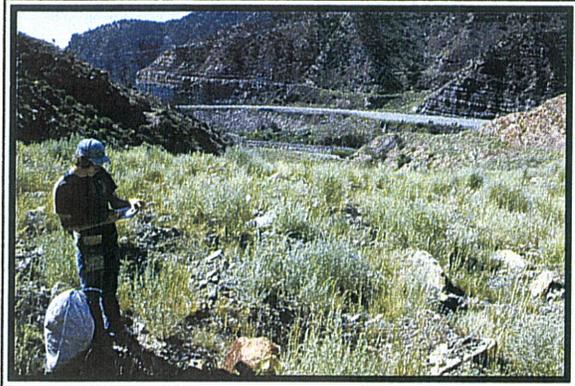




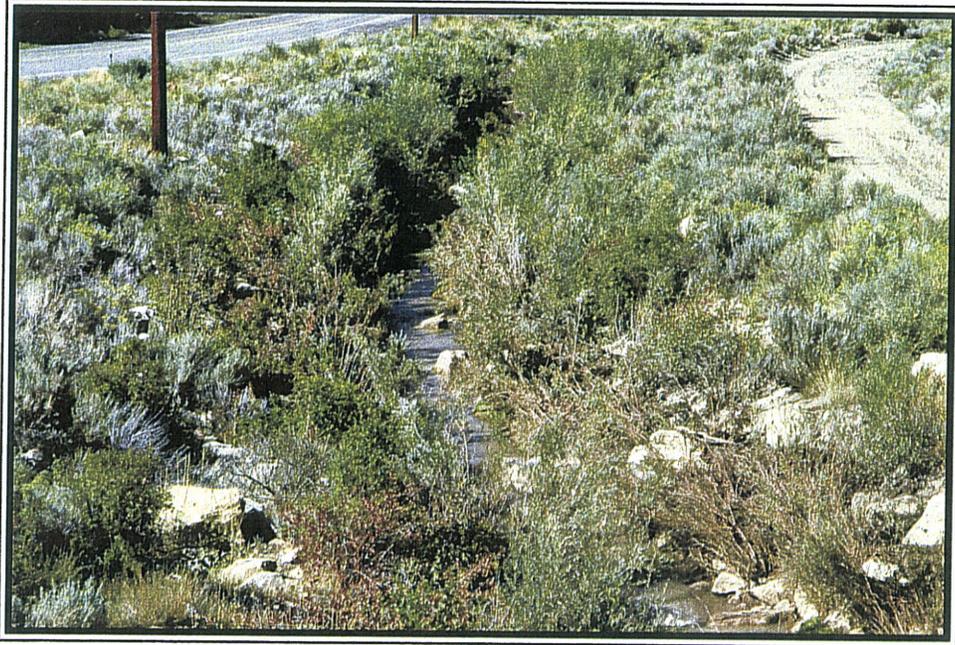
WILLOW CREEK RECLAIMED REFUSE PILE





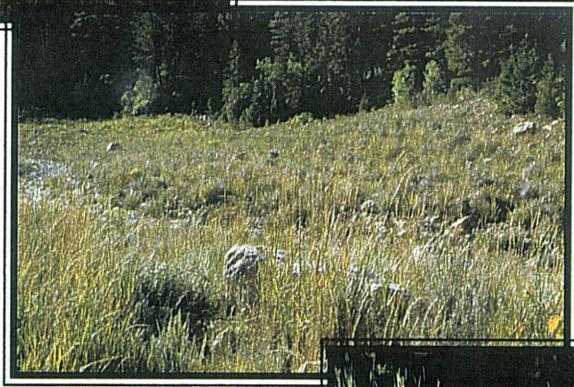


WILLOW CREEK RECLAIMED RIPARIAN BOTTOMS



CRANDALL CANYON RECLAIMED SAGEBRUSH AREAS

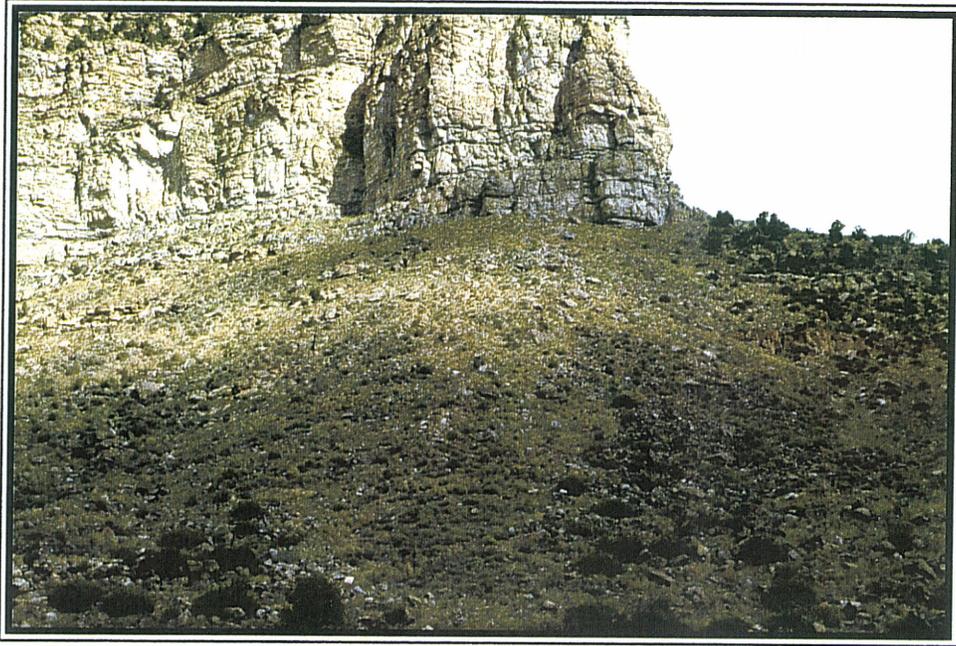




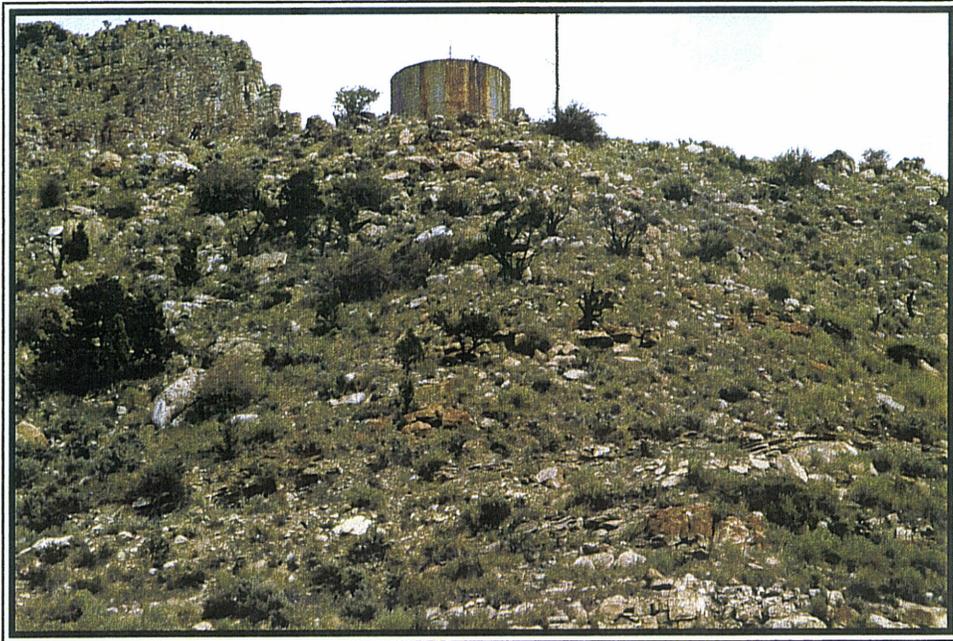
CRANDALL CANYON RECLAIMED MTN. BRUSH AREAS



CRANDALL CANYON (SB) REFERENCE AREA



MOUNTAIN BRUSH (MB) REFERENCE AREA



Attachment 2

**Phase II Bond Release
Sediment Yield Calculations**

**Mine Facilities Area/Conveyor Corridor
Sediment Yield Calculations**

**Sediment Yield Calculations
Pre-Disturbance vs. Post-Reclamation Condition
Conveyor Corridor New Reclamation
Plateau Mining Corporation**

Summary

The Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment yields from the area of the newly reclaimed Conveyor Corridor under both pre-disturbance and post-reclamation conditions. Details regarding this methodology and the associated references are provided on the following pages. Under the pre-disturbance condition, slopes were taken as 400 feet long. Deep gouging was used in reclaimed areas, thereby limiting the post-reclamation slope length to approximately 3 feet. The following calculations indicate that the post-reclamation sediment yield is estimated to be 0.09 ton/acre/year, while that of the same area under the pre-mining condition is estimated to have been 0.65 tons/acre/year. Hence, sediment yields are estimated to be substantially less after reclamation than before the area was disturbed by mining. The primary factor influencing this decrease in sediment yield was the use of deep gouging during site reclamation.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Mountain brush	10	0.19	25.30	0.08	0.17	0.65
Post-Reclamation						
Mountain brush	10	0.43	2.19	0.20	0.05	0.09

Notes:

1. $A = R K L S C P$, where A is the annual sediment yield (tons/acre/year). This is the Revised Universal Soil Loss Equation (RUSLE). Each of the coefficients is explained below.
2. R = Rainfall-Runoff Erosivity Factor (unitless) = 10 from Map R7 (Isrealson et al., 1984). R is identical for both the pre-disturbed and post-reclamation conditions.
3. K = Soil Erodibility Factor (unitless). The soil type for this location is the Shupert-Winetti complex (map unit #107 - see Jensen and Borchert, 1988). According to the soil survey, the K factor for Shupert is 0.24 (surface) and 0.49 (subsurface) and for Winetti is 0.15 (surface) and 0.37 (subsurface). As On-site soil was redistributed during reclamation. As a conservative measure, it was assumed that the pre-disturbance K factor was indicative of the surface soil (i.e., $K=0.19$ an average) while the post-reclamation K factor is equal to that of the subsurface soil (i.e., $K=0.43$ an average).
4. LS = Length-Slope Factor (unitless), taken from the following LS Calculation Table.
5. C = Cover Management Factor (unitless). Appendix 9-1 of the M&RP indicates that the Conveyor Corridor (Willow Creek) area consisted predominantly of Grassland-Sagebrush prior to disturbance. The reclaimed area consists primarily of Grassland-Sagebrush with a small Riparian area. Table 3.5, Appendix 9-1 of the M&RP indicates that the average percent cover in the applicable reference area (the Willow Creek Grassland-Sagebrush area) was 73.1% (39.6% vegetation and 33.5% litter/rock). Interpolating Table 8B.2 of Haan et al. (1994), assuming a "canopy of tall weeds or short brush" with a predominant surface cover of "grass, grasslike plants, decaying compacted duff, or litter", the C factor for the pre-disturbance condition was 0.08. Table 8B.5 of Haan et al. (1994) indicates that the C factor for an area that received mulch at a rate of 2 tons/ac with a slope of 40% is 0.20. As a conservative measure, this value will be assumed for the reclaimed area without taking into account additional erosion protection provided following the establishment of the revegetation cover.
6. P = Support Practice Factor (unitless). Under pre-disturbance conditions, the grade of the site was approximately 40%, with a direct outlet to the stream channel. Under reclamation conditions, the soil gouges retain all runoff and sediment, acting as a terrace with a closed outlet. According to Table 8.14D of Haan et al. (1994), the P factor under the two conditions would be 0.17 for the pre-disturbance scenario and 0.05 for the post-reclamation scenario.

References:

1. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press. San Diego, California.
2. Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.
3. Jensen, E.H. and J.W. Borchert, 1988. *Soil Survey of Carbon Area, Utah*. U.S. Natural Resources Conservation Service, Salt Lake City, Utah.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance	40.00	400	0.5	25.30
Post-Reclamation	40.00	3	0.5	2.19

Notes:

s = slope angle (%). The natural slopes immediately north and west of the disturbed area average approximately 40%. The steepest section of the reclaimed area has a slope of 40%, based on overall land slope and not the microslope within individual soil

l = slope length (ft). This value is defined as the distance from the origin of overland flow to the point of deposition or channelized flow. Slope lengths rarely exceed 400 feet, generally the presence of rocks, trees, and roads are conservatively estimated to limit the pre-disturbance slope length. 400 feet was the longest possible pre-disturbance length. Post-reclamation slope lengths are taken as 3 feet, which is the average distance from the top to the bottom of a deep gouge.

m = a factor in the LS equation which is 0.5 for slopes steeper

$$LS = ((65.41s^2/(s^2+10,000)) + 4.56s/(s^2+10,000)^{0.5} + 0.065) / (1/72.6)^m$$

(Israelsen et al., 1984)

Reference:

Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

**Refuse Pile
Sediment Yield Calculations**

**Sediment Yield Calculations
Pre-Disturbance vs. Post-Reclamation Condition
Willow Creek Refuse Pile
Plateau Mining Corporation**

Summary

The Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment yields from the area of the Willow Creek refuse pile under both pre-disturbance and post-reclamation conditions. Details regarding this methodology and the associated references are provided on the following pages. Under the pre-disturbance condition, slopes were taken as 400 feet long. Deep gouging was used in reclaimed areas, thereby limiting the post-reclamation slope length to approximately 3 feet. The following calculations indicate that the post-reclamation sediment yield is estimated to be 0.02 ton/acre/year, while that of the same area under the pre-mining condition is estimated to have been 0.15 tons/acre/year. Hence, sediment yields are estimated to be substantially less after reclamation than before the area was disturbed by mining. The primary factor influencing this decrease in sediment yield was the use of deep gouging during site reclamation.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Mountain brush/Grassland-Sagebrush	11	0.14	20.44	0.03	0.15	0.15
Post-Reclamation						
Mountain brush/Grassland-Sagebrush	11	0.31	0.71	0.14	0.05	0.02

Notes:

1. $A = R K L S C P$, where A is the annual sediment yield (tons/acre/year). This is the Revised Universal Soil Loss Equation (RUSLE). Each of the coefficients is explained below.
2. R = Rainfall-Runoff Erosivity Factor (unitless) = 11 from Map R7 (Isrealson et al., 1984). R is identical for both the pre-disturbed and post-reclamation conditions.
3. K = Soil Erodibility Factor (unitless). The soil type for this location is the Travessilla-Rock outcrop-Gerst complex (map unit #121 - see Jensen and Borchert, 1988). According to the soil survey, the K factor for this soil is 0.05 (surface) and 0.37 (subsurface) and for Rock outcroppings 0.24 (surface and subsurface). As On-site soil was redistributed during reclamation. As a conservative measure, it was assumed that the pre-disturbance K factor was indicative of the surface soil (i.e., $K=0.14$ an average) while the post-reclamation K factor is equal to that of the subsurface soil (i.e., $K=0.31$ an average).
4. LS = Length-Slope Factor (unitless), taken from the following LS Calculation Table.
5. C = Cover Management Factor (unitless). As the site was disturbed before 1977, pre-SMCRA, Barn Canyon immediately northwest of the site will be used as the pre-disturbance model. Appendix 9-1 of the M&RP indicates that the Barn Canyon area consisted predominantly of Conifer, Pinyon-Juniper, Mixed Brushland Grassland-Sagebrush. With the reclaimed refuse pile being located within the bottom of the canyon, it is assumed that the newly reclaimed area consisted primarily of Mountain Brush and Grassland-Sagebrush rather than Conifer and Pinyon-Juniper. Table 3.5, Appendix 9-1 of the M&RP indicates that the average percent cover in the applicable reference area (the Barn Canyon Mixed Brush area) was 98.0% (64.3% vegetation and 33.7% litter/rock) and (the Barn Canyon Grassland -Sagebrush area) was 98.9% (53.2% vegetation and 45.7% litter/rock). Interpolating Table 8B.2 of Haan et al. (1994), assuming a "canopy of tall weeds or short brush" with a predominant surface cover of "grass, grasslike plants, decaying compacted duff, or litter", the C factor for the pre-disturbance condition was 0.031. Table 8B.5 of Haan et al. (1994) indicates that the C factor for an area that received mulch at a rate of 2 tons/ac with a slope of 21 to 25% is 0.14. As a conservative measure, this value will be assumed for the reclaimed area without taking into account additional erosion protection provided following the establishment of the revegetation cover.

6. P = Support Practice Factor (unitless). Under pre-disturbance conditions, the grade of the site was approximately 35%, with a direct outlet to the stream channel. Under reclamation conditions, the soil gouges retain all runoff and sediment, acting as a terrace with a closed outlet. According to Table 8.14D of Haan et al. (1994), the P factor under the two conditions would be 0.15 for the pre-disturbance scenario and 0.05 for the post-reclamation scenario.

References:

1. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press. San Diego, California.
2. Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.
3. Jensen, E.H. and J.W. Borchert, 1988. *Soil Survey of Carbon Area, Utah*. U.S. Natural Resources Conservation Service, Salt Lake City, Utah.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance	35.00	400	0.5	20.44
Post-Reclamation	20.00	3	0.5	0.71

Notes:

s = slope angle (%). The average slope within the canyon above the disturbed area of the canyon are approximately 35%. The steepest section of the reclaimed area has a slope of 35%. The Average reclaimed slope is approximately 20%, based on overall land slope and not the microslope within individual soil gouges.

l = slope length (ft). This value is defined as the distance from the origin of overland flow to the point of deposition or channelized flow. Slope lengths rarely exceed 400 feet, generally the presence of rocks, trees, and roads are conservatively estimated to limit the pre-disturbance slope length. To be conservative a length of 400 feet was used for pre-disturbance. Post-reclamation slope lengths are taken as 3 feet, which is the average distance from the top to the bottom of a deep gouge.

m = a factor in the LS equation which is 0.5 for slopes steeper than 5%.

$LS = ((65.41s^2/(s^2+10,000)) + 4.56s/(s^2+10,000)^{0.5} + 0.065) / (1/72.6)^m$
(Israelsen et al., 1984)

Reference:

Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

**Gravel Canyon
Sediment Yield Calculations**

**Sediment Yield Calculations
Pre-Disturbance vs. Post-Reclamation Condition
Gravel Canyon New Reclamation
Plateau Mining Corporation**

Summary

The Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment yields from the area of the newly reclaimed Gravel Canyon under both pre-disturbance and post-reclamation conditions. Details regarding this methodology and the associated references are provided on the following pages. Under the pre-disturbance condition, slopes were taken as 100 feet long. Deep gouging was used in reclaimed areas, thereby limiting the post-reclamation slope length to approximately 3 feet. The following calculations indicate that the post-reclamation sediment yield is estimated to be 0.002 ton/acre/year, while that of the same area under the pre-mining condition is estimated to have been 0.05 tons/acre/year. Hence, sediment yields are estimated to be substantially less after reclamation than before the area was disturbed by mining. The primary factor influencing this decrease in sediment yield was the use of deep gouging during site reclamation.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Mountain brush	10	0.16	2.56	0.10	0.12	0.05
Post-Reclamation						
Mountain brush	10	0.10	0.44	0.07	0.05	0.002

Notes:

1. $A = R K L S C P$, where A is the annual sediment yield (tons/acre/year). This is the Revised Universal Soil Loss Equation (RUSLE). Each of the coefficients is explained below.
2. R = Rainfall-Runoff Erosivity Factor (unitless) = 10 from Map R7 (Isrealsen et al., 1984). R is identical for both the pre-disturbed and post-reclamation conditions.
3. K = Soil Erodibility Factor (unitless). The soil type for this location is the Pathead-Curecanti family association (map unit #72 - see Jensen and Borchert, 1988). According to the soil survey, the K factor for Pathead is 0.05 (surface) and 0.10 (subsurface) and for Curecanti is 0.28 (surface) and 0.10 (subsurface). As On-site soil was redistributed during reclamation. As a conservative measure, it was assumed that the pre-disturbance K factor was indicative of the surface soil (i.e., $K=0.16$ an average) while the post-reclamation K factor is equal to that of the subsurface soil (i.e., $K=0.10$).
4. LS = Length-Slope Factor (unitless), taken from the following LS Calculation Table.
5. C = Cover Management Factor (unitless). Section 3.6 of the M&RP indicates that the Gravel Canyon area was disturbed prior to 1977 and is considered pre-SMCRA. North facing slopes above the disturbed area contain both Conifers and Mixed Brush. South facing slopes above the disturbed area contain Juniper-Pinyon and Mixed Brush. The reclaimed site will contain Mixed Brush as it is at the bottom of the canyon. Interpolating Table 8B.2 of Haan et al. (1994), assuming a "canopy of tall weeds or short brush" with a predominant surface cover of "grass, grasslike plants, decaying compacted duff, or litter", the C factor for the pre-disturbance condition was 0.10. Table 8B.5 of Haan et al. (1994) indicates that the C factor for an area that received mulch at a rate of 2 tons/ac with a slope of 11 to 15% is 0.07. As a conservative measure, this value will be assumed for the reclaimed area without taking into account additional erosion protection provided following the establishment of the revegetation cover.
6. P = Support Practice Factor (unitless). Under pre-disturbance conditions, the grade of the site was approximately 15%, with a direct outlet to the stream channel. Under reclamation conditions, the soil gouges retain all runoff and sediment, acting as a terrace with a closed outlet. According to Table 8.14D of Haan et al. (1994), the P factor under the two conditions would be 0.12 for the pre-disturbance scenario and 0.05 for the post-reclamation scenario.

References:

1. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press. San Diego, California.
2. Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.
3. Jensen, E.H. and J.W. Borchert, 1988. *Soil Survey of Carbon Area, Utah*. U.S. Natural Resources Conservation Service, Salt Lake City, Utah.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance	15.00	100	0.5	2.56
Post-Reclamation	15.00	3	0.5	0.44

Notes:

s = slope angle (%). The average slope within the canyon from immediately upstream of the disturbed area to the bottom of the canyon averages approximately 15%. The steepest section of the reclaimed area has a slope of 15%, based on overall land slope and not the microslope within individual soil gouges.

l = slope length (ft). This value is defined as the distance from the origin of overland flow to the point of deposition or channelized flow. Slope lengths rarely exceed 400 feet, and in this case, the presence of rocks, trees, and roads are conservatively estimated to limit the pre-disturbance slope length to 100 feet. Post-reclamation slope lengths are taken as 3 feet, which is the average distance from the top to the bottom of a

m = a factor in the LS equation which is 0.5 for slopes steeper

$$LS = ((65.41s^2/(s^2+10,000)) + 4.56s/(s^2+10,000)^{0.5} + 0.065) / (1/72.6)^m$$

(Israelsen et al., 1984)

Reference:

Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

**Crandall Canyon
Sediment Yield Calculations**

Sediment Yield Calculations
Pre-Disturbance vs. Post-Reclamation Condition
Crandall Canyon
Plateau Mining Corporation

Summary

The Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment yields from the area of the reclaimed Crandall Canyon under both pre-disturbance and post-reclamation conditions. Details regarding this methodology and the associated references are provided on the following pages. Under the pre-disturbance condition, slopes were taken as 100 feet long. Deep gouging was used in reclaimed areas, thereby limiting the post-reclamation slope length to approximately 3 feet. The following calculations indicate that the post-reclamation sediment yield is estimated to be 0.02 ton/acre/year, while that of the same area under the pre-mining condition is estimated to have been 2.32 tons/acre/year. Hence, sediment yields are estimated to be substantially less after reclamation than before the area was disturbed by mining. The primary factor influencing this decrease in sediment yield was the use of deep gouging during site reclamation.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Mountain brush	11	0.05	42.24	0.10	1.0	2.32
Post-Reclamation						
Mountain brush	11	0.10	2.19	0.20	0.05	0.02

Notes:

1. $A = R K L S C P$, where A is the annual sediment yield (tons/acre/year). This is the Revised Universal Soil Loss Equation (RUSLE). Each of the coefficients is explained below.
2. R = Rainfall-Runoff Erosivity Factor (unitless) = 11 from Map R7 (Isrealson et al., 1984). R is identical for both the pre-disturbed and post-reclamation conditions.
3. K = Soil Erodibility Factor (unitless). The soil type for this location is the Pathead extremely bouldery fine sandy loam, 40 to 70 percent slopes (map unit #71 - see Jensen and Borchert, 1988). According to the soil survey, the K factor for this soil is 0.05 (surface) and 0.10 (subsurface). As On-site soil was redistributed during reclamation. As a conservative measure, it was assumed that the pre-disturbance K factor was indicative of the surface soil (i.e., $K=0.05$) while the post-reclamation K factor is equal to that of the subsurface soil (i.e., $K=0.10$).
4. LS = Length-Slope Factor (unitless), taken from the following LS Calculation Table
5. C = Cover Management Factor (unitless). Appendix 9-1 of the M&RP indicates that the Crandall Canyon area consisted predominantly of Mixed Brush and Riparian Bottom prior to disturbance. With the bulk of the area being elevated above the natural channel, it is assumed that the reclaimed area consisted primarily of Mixed Brush rather than Riparian Bottom. Table 3.5, Appendix 9-1 of the M&RP indicates that the average percent cover in the applicable reference area (the Castle Gate Mixed Brush area) was 76.1% (40.9% vegetation and 35.2% litter/rock). Interpolating Table 8B.2 of Haan et al. (1994), assuming a "canopy of tall weeds or short brush" with a predominant surface cover of "grass, grasslike plants, decaying compacted duff, or litter", the C factor for the pre-disturbance condition was 0.10. Table 8B.5 of Haan et al. (1994) indicates that the C factor for an area that received mulch at a rate of 2 tons/ac with a slope of 34 to 50% is 0.20. As a conservative measure, this value will be assumed for the reclaimed area without taking into account additional erosion protection provided following the e
6. P = Support Practice Factor (unitless). Under pre-disturbance conditions, the grade of the site was approximately 100%, with a direct outlet to the stream channel. Under reclamation conditions, the soil gouges retain all runoff and sediment, acting as a terrace with a closed outlet. According to Table 8.14D of Haan et al. (1994), the P factor under the two conditions would be 1.0 for the pre-disturbance scenario and 0.05 for the post-reclamation scenario.

References:

1. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press. San Diego, California.
2. Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.
3. Jensen, E.H. and J.W. Borchert, 1988. *Soil Survey of Carbon Area, Utah*. U.S. Natural Resources Conservation Service, Salt Lake City, Utah.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance	100.00	100	0.5	42.24
Post-Reclamation	40.00	3	0.5	2.19

Notes:

s = slope angle (%). The natural slope immediately outside the disturbed area averages approximately 100%. The steepest section of the reclaimed area has a slope of 40%, based on overall land slope and not the microslope within individual soil gouges.

l = slope length (ft). This value is defined as the distance from the origin of overland flow to the point of deposition or channelized flow. Slope lengths rarely exceed 400 feet, and in this case, the presence of rocks, trees, and roads are conservatively estimated to limit the pre-disturbance slope length to 100 feet. Post-reclamation slope lengths are taken as 3 feet, which is the average distance from the top to the bottom of a

m = a factor in the LS equation which is 0.5 for slopes steeper

$$LS = ((65.41s^2/(s^2+10,000)) + 4.56s/(s^2+10,000)^{0.5} + 0.065) / (1/72.6)^m$$

(Israelsen et al., 1984)

Reference:

Israelsen, C.E., J.E. Fletcher, F.W. Haws, and E.K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

Attachment 3

**Phase II Bond Release
Public Notice**

Public Notice
Application for Phase II Bond Release
Plateau Mining Corporation, Willow Creek Mine
Permit C/007/0038, Renewed 04/24/2011

Notice is hereby given that Plateau Mining Corporation, P.O. Box 30, Helper, Utah 84526, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining pursuant to R645-301-880 for Phase II bond release for the Willow Creek Mine, Permit C/007/0038. The Phase II bond release applies to the 94.40 acres that remain in the Disturbed Area Boundary. This bond release application is based on meeting the vegetation and water quality requirements for Phase II reclamation in accordance with the approved reclamation plan pursuant to the Utah Coal Program Regulations.

In accordance with the provision of R645-301-880, of the State of Utah R645 Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for partial release of the performance bond posted for this property. The surety bond posted for the Willow Creek Mine is \$1,424,514; Plateau Mining Corporation is seeking release of \$935,348 which will reduce the bond to \$489,166.

The permit area is shown on the Helper, Standardville and Kyune U.S. Geological Survey 7.5-minute maps. The portion of the permit area that is affected contains a total of 94.40 acres and is located in Carbon County, Utah as follows:

Sec. 35, T. 12 S., R. 9 E. NE $\frac{1}{4}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SE $\frac{1}{4}$

Sec. 36, T. 12 S., R. 9 E. NE $\frac{1}{4}$ SW $\frac{1}{4}$, NW $\frac{1}{4}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$

Sec. 22, T. 12 S., R. 9 E. SE $\frac{1}{4}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$

Sec. 27, T. 12 S., R. 9 E. NE $\frac{1}{4}$ NW $\frac{1}{4}$, NW $\frac{1}{4}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$ NW $\frac{1}{4}$, NW $\frac{1}{4}$ SW $\frac{1}{4}$

Sec. 28, T. 12 S., R. 9 E. NE $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$, NW $\frac{1}{4}$ SE $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$

Sec. 1, T. 13 S., R. 9 E. NE $\frac{1}{4}$ NE $\frac{1}{4}$, NW $\frac{1}{4}$ NE $\frac{1}{4}$, SW $\frac{1}{4}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ NE $\frac{1}{4}$, NE $\frac{1}{4}$ NW $\frac{1}{4}$, NW, $\frac{1}{4}$ NW $\frac{1}{4}$,

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

Written comments, objections and requests for public hearing or informal conference on this proposal may be addressed to:

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or informal conference on this proposal must be submitted by _____, 2012.

Published in the Sun Advocate - _____, _____, _____, and _____, 2012

Attachment 4

**Phase II Bond Release
Landowner and Government Agency Notification**

PLATEAU MINING CORPORATION

May 1, 2012

Mr. Hugh Kirkham
State of Utah
Department of Transportation
940 South Carbon Avenue
Price, Utah 84501

Re: Notification of Application for Phase II Bond Release, Plateau Mining Corporation, Willow Creek Mine, C/007/038, Carbon County, Utah

Dear Mr. Kirkham:

Plateau Mining Corporation, P.O. Box 30, Helper, UT 84526, has completed Phase II of the approved reclamation plan for the remaining 95.40 acres of land in the Willow Creek Permit. This Phase II bond release application is based meeting the vegetation and water quality requirement for Phase II reclamation in accordance with the approved reclamation plan.

In accordance with the requirements of R645-301-880, of the State of Utah R645-Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for partial release of the performance bond posted for this operation. The bond posted for the Willow Creek Mine is \$1,424,514 from which Plateau Mining Corporation is seeking Phase II release of \$935,348.

The permit area is shown on the Helper, Standardville and Kyune U.S. Geological Survey 7.5-minute maps. The portion of the permit area that is affected contains a total of 94.40 acres and is located in Carbon County, Utah as follows:

Sec. 35, T. 12 S., R. 9 E.	NE $\frac{1}{4}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SE $\frac{1}{4}$
Sec. 36, T. 12 S., R. 9 E.	NE $\frac{1}{4}$ SW $\frac{1}{4}$, NW $\frac{1}{4}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$
Sec. 22, T. 12 S., R. 9 E.	SE $\frac{1}{4}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$
Sec. 27, T. 12 S., R. 9 E.	NE $\frac{1}{4}$ NW $\frac{1}{4}$, NW $\frac{1}{4}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$ NW $\frac{1}{4}$, NW $\frac{1}{4}$ SW $\frac{1}{4}$
Sec. 28, T. 12 S., R. 9 E.	NE $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$, NW $\frac{1}{4}$ SE $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$
Sec. 1, T. 13 S., R. 9 E.	NE $\frac{1}{4}$ NE $\frac{1}{4}$, NW $\frac{1}{4}$ NE $\frac{1}{4}$, SW $\frac{1}{4}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ NE $\frac{1}{4}$, NE $\frac{1}{4}$ NW $\frac{1}{4}$, NW, $\frac{1}{4}$ NW $\frac{1}{4}$,

Comments concerning Phase II bond release from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies which would have to initiate, implement, approve or authorize the proposed use of the land following reclamation should be mailed to: Plateau Mining Corporation, Attention: Dennis Ware, P.O. Box 30 Helper, Utah 84526.

Sincerely,

Dennis Ware
Company Representative
(435) 472-4737
dware@alphanr.com

Mailed to:

Carbon County Planning and Zoning
120 East Main Street
Price, Utah 84501

Director Land Management
Blackhawk Coal Company
700 Morrison Road
Gahanna, Ohio 43230-6642

Helper City
P.O. Box 221
Helper, Utah 84526

Utah Power and Light
Carbon Plant
Helper, Utah 84526

Carbon County Commissioners
120 East Main Street
Price, Utah 84501

Price River Water Improvement District
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501

Bureau of Land Management
125 South 600 West
Price, Utah 84501

Director
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

State of Utah
Department of Transportation
940 South Carbon Avenue
Price, Utah 84501

Mr. Reed Martineau
Snow, Christensen & Martineau
P.O. Box 45000
Salt Lake City, Utah 84145-5000

Attachment 5

**Phase II Bond Release
Reclamation Certification**

Plateau Mining Corporation
Willow Creek Mine
C/007/0038

Phase II Bond Release on 95.40 acres of land which is in Willow Creek Mine Permit C/007/0038.

I hereby certify to the best of my information and belief all the information contained in this application for phase II bond release is true and correct and that all applicable reclamation activities have been accomplished in accordance with the requirement of the Act, the regulatory program and the approved reclamation plan.

Dennis N. Ware
Print Name

Company Representative
Position

Dennis N. Ware 4/30/2012
Signature, Date

Subscribed and sworn to before me this 30th day of April, 2012

Ruane Leeflang
Notary Public



My Commission Expires: 6-30, 2013

Attest: State of Utah
County of Emery

Attachment 6

**Phase II Bond Release
Bond Release Calculation**

Willow Creek Mine Phase II Bond Reduction

Rule R645-301-880.320 "...When determining the amount of bond to be released after successful revegetation has been established, the Division will retain that amount of bond for the revegetated area which would be sufficient to cover the cost of reestablishing revegetation if completed by a third party for the period specified for operator responsibility in UCA 40-10-17(t) of the Act for reestablishing revegetation. ..."

The current Willow Creek Mine Permit bond calculation worksheets can be found in the Willow Creek MRP in Volume 9, Exhibit 17. A copy of the summary page related to revegetation is included in this Attachment. These bond calculations in Exhibit 17 were updated and incorporated into the permit in December of 2001 and are in 2001 dollars. Exhibit 17 shows the cost to revegetate which includes the cost of "pocking". If the reclaimed land were to require revegetation the pocking that took place in the initial revegetation would not be necessary. The costs used to calculate the amount of bond to be held by the Division after phase II bond release include all the direct revegetation cost from Exhibit 17 (except for the pocking cost) including a 25% reseeding rate, indirect cost which total 26.8% and escalation costs from 2001 dollars to 2012 dollars. The cost to revegetate has been calculated to be from \$8,385/acre to \$8,447 per acre depending on the specific site in the permit. The "Willow Creek Mine – Phase II Bond Release Calculation Worksheet" (attached) provides the details of this reseeding cost per acre calculation.

In order to determine the amount of bond to be retained by the Division after phase II bond release we must determine the cost to revegetate the acres within the DAB that remain in the permit. Over time certain acres within the Disturbed Area Boundary (DAB) were removed from the permit as part of a change in the post mining land use to industrial. In the Willow Creek Permit this includes acres sold to the College of Eastern Utah which were part of the Mine Facilities/Conveyor Corridor portion of the permit and acres sold to the Price River Water Conservancy District which were part of the Preparation Plant, Loadout and Refuse Pile portion of the permit. Also, the Barn Canyon Shaft Facility was removed from the permit as this area was never disturbed. Of the remaining acres (those not removed from the permit) within the DAB, not all were revegetated in the reclamation cycle due to the fact that not all of these acres were disturbed or that a portion of these acres exist as a permanent road. Refer to Attachment #7 of this application for a detailed map of the acres remaining in the DAB and the acres actual disturbed and reclaimed and revegetated within the DAB. Also refer to the table 4.5-1 which is also a part of this Bond Release Application.

Utilizing the cost to revegetate per acre multiplied by the applicable acres in the permit, the bond amount after phase II release is calculated to be \$489,166. The current bond amount is \$1,424,514. Therefore the amount of bond release is calculated to be \$935,348. (see the attached "Willow Creek Mine- Phase II Bond Release Calculation Table" on the following page)

Willow Creek Mine - Phase II Bond Release Calculation Worksheet

Willow Creek Seeding Cost taken from the Willow Creek MRP, Volume 9, Exhibit 17

Description	Materials	Means #	Unit Cost	Unit	Surface Facilities/Conveyor Corridor		Prep. Plant, Loadout and Refuse Pile		Gravel Canyon		Crandall Canyon		Totals
					Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
Initial Seeding													
Place Hay Mulch	Hay, 1" deep, power mulcher large	02910 500 0350	23	MSF	2215	\$50,945	3132	\$72,036	218	\$6,014	800	\$18,400	
Seeding	Hydro Seeding with mulch and fertilizer	02920 510 1700	38	MSF	2215	\$84,170	3132	\$119,016	218	\$8,284	800	\$30,400	
Place Hay Mulch	Hay, 1" deep, power mulcher large	02910 500 0350	23	MSF	2215	\$50,945	3132	\$72,036	218	\$6,014	800	\$18,400	
Seeding Bareroot	Bareroot Seeding	02912 350 0561	0.79	EA	0	\$0	0	\$0	0	\$0	600	\$474	
Total Direct Cost of Initial Seeding						\$186,060		\$263,088		\$18,312		\$67,674	\$535,134
Assume 25% Reseeding Rate						\$46,515		\$65,772		\$4,578		\$16,919	\$133,784
Total Direct Cost of Seeding in Bond						\$232,575		\$328,860		\$22,890		\$84,593	\$668,918

Increase Direct Cost of Seeding by Adding Indirect Costs and Escalate to 2012 Dollars

Indirect Costs	Surface Facilities/Conveyor Corridor		Prep. Plant, Loadout and Refuse Pile		Gravel Canyon		Crandall Canyon	
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Mob/Demob (10.0%)		\$23,258		\$32,886		\$2,289		\$8,459
Contingency (5.0%)		\$11,629		\$16,443		\$1,145		\$4,230
Engineering Redesign (2.5%)		\$5,814		\$8,222		\$572		\$2,115
Main Office Expense (6.8%)		\$15,815		\$22,362		\$1,557		\$5,752
Project Management Fee (2.5%)		\$5,814		\$8,222		\$572		\$2,115
Subtotal Indirect Costs (26.8%)		\$62,330		\$88,135		\$6,135		\$22,671
Total Direct and Indirect Cost or Reseeding in 2001 Dollars		\$294,905		\$416,995		\$29,025		\$107,264
Escalation (3.12% for 11 years)		\$131,475		\$185,906		\$12,940		\$47,820
Total Direct Cost and Indirect Cost or Reseeding in 2012 Dollars		\$426,380		\$602,901		\$41,965		\$155,084

Convert Total Direct and Indirect Cost of Seeding to Cost Per Acre and Apply to Acres Remaining in the Permit/Bond

Convert Direct and Indirect Cost of Seeding Cost to Cost/Acre	Surface Facilities/Conveyor Corridor		Prep. Plant, Loadout and Refuse Pile		Gravel Canyon		Crandall Canyon		Totals
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
Acres used in Bond Calculation (includes acres changed to industrial and acres removed from the bond/permit)	50.85	\$8,385.06	71.90	\$8,385.27	5.01	\$8,384.61	18.36	\$8,446.84	146.12
Total Direct and Indirect Cost of Seeding per Acre in 2012 Dollars		\$163.91		\$116.12		\$1673.41		\$460.01	\$1000.45
Actual Acres Seeded (only those acres that were actually seeded which remain in the bond/permit)	11.77	\$1,909.92	(A) 26.23	\$4,299.96	4.29	\$70,429.70	(B) 15.93	\$2,558.16	58.22
Total Direct and Indirect Cost of Seeding the Remaining acres in the permit/bond		\$98,692		\$219,946		\$35,970		\$134,558	\$489,166

NOTES:

- (A) 26.01 acres seeded at the Refuse Pile and 0.22 acres seeded at the Loadout for a total of 26.23 total acres seeded
 - (B) 15.24 acres seeded at the Crandall Canyon Facilities area and 0.69 acres seeded at the Crandall Canyon Topsoil Stockpile area for a total of 15.93 acres seeded
- For a detailed view of all of the acreage numbers by area see the Phase II Reclamation Maps in Attachment 7 of this Bond Release Application

Current Bond, Bond Reduction and Bond Remaining After Phase II Bond Release

Current Bond	Surface Facilities/Conveyor Corridor		Prep. Plant, Loadout and Refuse Pile		Gravel Canyon		Crandall Canyon		Totals
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
Bond to Remain After Phase II Bond Reduction	\$289,514 (C)	\$571,000		\$63,600		\$500,400		\$1,424,514	
Bond Reduction	\$98,692	\$219,946		\$35,970		\$134,558		\$489,166	
Bond Remaining	\$190,822	\$351,054		\$27,630		\$365,842		\$935,348	

Attachment 7

**Phase II Bond Release
Maps**

LEGEND

	100' CONTOUR INTERVAL
	50' CONTOUR INTERVAL
	25' CONTOUR INTERVAL
	10' CONTOUR INTERVAL
	5' CONTOUR INTERVAL
	2.5' CONTOUR INTERVAL
	1.25' CONTOUR INTERVAL
	0.625' CONTOUR INTERVAL
	0.3125' CONTOUR INTERVAL
	0.15625' CONTOUR INTERVAL
	0.078125' CONTOUR INTERVAL
	0.0390625' CONTOUR INTERVAL
	0.01953125' CONTOUR INTERVAL
	0.009765625' CONTOUR INTERVAL
	0.0048828125' CONTOUR INTERVAL
	0.00244140625' CONTOUR INTERVAL
	0.001220703125' CONTOUR INTERVAL
	0.0006103515625' CONTOUR INTERVAL
	0.00030517578125' CONTOUR INTERVAL
	0.000152587890625' CONTOUR INTERVAL
	0.0000762939453125' CONTOUR INTERVAL
	0.00003814697265625' CONTOUR INTERVAL
	0.000019073486328125' CONTOUR INTERVAL
	0.0000095367431640625' CONTOUR INTERVAL
	0.00000476837158203125' CONTOUR INTERVAL
	0.000002384185791015625' CONTOUR INTERVAL
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	0.000000298023223876953125' CONTOUR INTERVAL
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	0.00000007450580596923828125' CONTOUR INTERVAL
	0.000000037252902984619140625' CONTOUR INTERVAL
	0.0000000186264514923095703125' CONTOUR INTERVAL
	0.00000000931322574611478515625' CONTOUR INTERVAL
	0.000000004656612873057392578125' CONTOUR INTERVAL
	0.0000000023283064365286962890625' CONTOUR INTERVAL
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	0.0000000000011368683772112773863647109375' CONTOUR INTERVAL
	0.00000000000056843418861388869318235546875' CONTOUR INTERVAL
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	0.00000000000007105427357673608664744443359375' CONTOUR INTERVAL
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	0.00000000000000888178419709201083090546875' CONTOUR INTERVAL
	0.000000000000004440892098546005415452734375' CONTOUR INTERVAL
	0.0000000000000022204460492730027277261875' CONTOUR INTERVAL
	0.00000000000000111022302463650136386309375' CONTOUR INTERVAL
	0.000000000000000555111512318250681931546875' CONTOUR INTERVAL
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	0.0000000000000000002710505431241458404261875' CONTOUR INTERVAL
	0.000000000000000000135525271562072920213671875' CONTOUR INTERVAL
	0.000000000000000000067762635781036460108359375' CONTOUR INTERVAL
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	0.000000000000000000016940658945259002502734375' CONTOUR INTERVAL
	0.00000000000000000000847032947262950125013671875' CONTOUR INTERVAL
	0.000000000000000000004235164736314750625068359375' CONTOUR INTERVAL
	0.0000000000000000000021175823681572875031250346875' CONTOUR INTERVAL
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	0.000000000000000000000529395592039318750078125008671875' CONTOUR INTERVAL
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