1984 ANNUAL RECLAMATION REPORT

STAR POINT MINES

Plateau Mining Company
December 1984

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This report is submitted in accordance with the Plateau Mining Company MRP ACT/007/006 Special Stipulation #10(c) which requires that an annual revegetation monitoring report be submitted to the Division by December 1 of each year. Field data was collected in July 1984 on all revegetated sites, research study plots, and the Wildlife Mitigation Area. Reclaimed sites sampled were the 1980, 1981 and 1983 seedings. Study areas sampled were the Barrow Area, Refuse Pile Topsoil, Office-Road-Cut, and Wildlife Mitigation Area. Locations are presented on Map 1 and 2, Plateau Mining Company 1984 Reclamation. Each of these areas are described in the following narrative along with a discussion of the results and conclusion that can be made from the 1984 data. Additional details on the reclamation practices used on these areas can be found in the 1983 Annual Reclamation Report for the Star Point Mines submitted to UDOGM in January 1984.

Methods

The parameters measured on the various sites presented in this report includes plant cover, current annual plant production, plant densities, plant survival. Not all parameters were measured on all sites. A list of the measurements taken on each site is presented in the description section associated with each particular site. Methods used are based on those recommended in Appendix I, Utah Division of Oil, Gas and Mining, "Vegetation Information Guideline". Methods used on the Refuse Pile Vegetation Test Plots were approved by the Division in Lynn Kunzler's August 1, 1984 memo to Coal File", ACT 007/006. A copy of this memo is contained in Exhibit A.

Cover

Cover estimates were measured using a ten-point frame on the topsoil stockpiles, subsoil stockpiles, and on the Refuse Pile Vegetation Test Plots. Cover on the Refuse Pile Vegetation Test Plots was derived from eight 50' transects per slope treatment. The ten-point frame was placed at 5' intervals along the transect for a total of 100 observations. Each

observation was recorded by plant species, litter or bareground. Average cover per transect was used in the statistical analysis. Random transects were used on the topsoil and subsoil stockpile.

Reclaimed sites were measured for cover by reading the percent cover by species within a 20 x 50 centimeter quadrat. In 1983, cover was measured on reclaimed sites using a ten-point frame. However, due to the extreme difficulty and safety hazards of traversing the rocky steep slopes, often in excess of 60%, common on most of the reclaimed sites, with a ten-point frame, it was decided to use a more portable 20 x 50 cm quadrat and a short transect tape. Percent cover by species was read from three 20 x 50 cm quadrats per 14.52 foot transect. The transect was randomly placed and were also used to calculate shrub density. The short transects and small quadrat were rapid to read and allowed more observations compared to the 50m transects used in 1983; they were implemented because of the increased safety involved.

Production

Production was measured by clipping three ¼m^2 quadrats per transect on the Refuse Pile Vegetation Test Plots. On the remaining reclaimed sites, subsoil stockpile, and Wildlife Mitigation Area, production was measured by clipping randomly placed ¼m^2 quadrats. Plant samples were clipped by life form, oven dried, and weighed to the nearest 0.01 gram. Transect averages were used for statistical analysis on the Refuse Pile Vegetation Test Plots while plot totals were used on the reclaimed and wildlife mitigation areas.

Plant Densities

Plant densities were measured on the 1983 reclamation by counting the number of seedlings within a 20 x 50 centimeter plot. Woody plant densities were measured on the Refuse Pile Vegetation Test Plots from eight 3' x 50' belt transects per treatment. Shrub densities on reclaimed sites and wildlife mitigation area were measured from randomly placed 3' x 14.52' belt transects, which represent 0.001 acres.

Seed Mixtures

Seed mixtures that have been planted are given in Exhibit B, Seed Mixtures Used at Plateau Mining Company.

RECLAIMED SITES

Description

For the most part, relcaimed sites are associated with road cuts and fills. Measurements were taken on all reclaimed sites for plant cover by species, total current annual production and woody plant density. Seedling density was taken on the 1983 reclamation seeding in order to determine the relative germination and plant establishment. A summary of these data is presented in Table 1, 1984 Summary of Revegetation Data on Reseeded Sites. Seed Mixtures are presented in Exhibit B, Reclamation Seed Mixtures.

Results and Discussion

1980 Seedings

Third year cover on the 1980 reclamation seeding as delineated on the 1984 Reclamation Map was found to equal 12.13% with 1,236 pounds per acre of air dry forage. Woody plant density was found to equal 183 stems per acre. The reclaimed plant community is made of predominately intermediate wheatgrass and alfalfa. These two species represent 50% of the relative composition while Salina wildrye, desert wheatgrass and yellow sweetclover make up an additional 31%. There are seven species with 3% or greater of the overall composition. A total of 20 species were encountered in the cover transects. A complete review of the 1980 seeding data is presented in Table 2, Summary of the 1980 Reclamation Seeding. There were no data collected on these sites in 1983.

1981 Seedings

The 1981 seeding is also successful. It has a percent plant cover of 22.83 percent and produces 1,906 pounds per acre of air dry forage. There is an average of 789 shrubs per acre represented by eight shrub species. Data collected in 1983 revealed a cover value of 15.67%, production at 508

pounds per acre, and woody plant density at 149 stems per acre. The 1984 data indicates an increase over 1983 data for all three parameters. These increases may be attributed in part, to the fact that 1984 was a higher precipitation year and the 1983 sampling was restricted to the more gentle slopes. Sampling methods used in 1984 allowed for data collection from all sites regardless of steepness of slope.

The predominant shrubs are fourwing saltbrush, sagebrush and rabbitbrush. The plant community overall is comprised of 14 species encountered in the cover transects with another seven additional shrub species which were encountered in the woody plant density belt transects. A total of 21 species were found growing on the site. Of these, the composition of intermediate wheatgrass, alfalfa, and yellow sweetclover make up 82% of the community. There are five species with relative composition values greater than 3%. Table 3, 1984 Summary of the 1981 Seeding contains a complete compilation of the data.

1983 Seedings

In 1983, several locations were reseeded as shown on the 1984 Reclamation Map. Originally, these sites were seeded in 1980 and 1981. Due to low plant cover on these sites, they were reseeded in 1983. Also, approximately 2.05 acres of the subsoil stockpile as shown on the 1984 Reclamation Map, was seeded in the Fall of 1983. Seedling density data was collected from these sites in order to determine the initial successfulness of plant establishment. Perennial grass establishment for the first year after seeding is 1.25 seedlings per square foot on the reclaimed sites and 2.65 seedlings per square foot on the subsoil stockpile site. Perennial forbs are 0.01 and 1.35 per square foot, respectively. Annuals account for 0.97 per square foot on the reclaimed sites and 0.56 per square foot on the subsoil site. Both sites appear to have a seedling density that will provide good ground cover by the second growing season. A review of the results is presented in Table 4, 1984 Summary of the 1983 Seedlings.

Topsoil and Subsoil Stockpiles

Data was collected on the topsoil stockpile and the subsoil stockpile as shown on the 1984 Reclamation Map. The topsoil stockpile was found to have a plant cover of 54.4% and a current annual production of 1,688 pounds per acre. This compares with a plant cover of 45.55% in 1983. Relative composition was found to equal 67.3% annual plants, as compared to 70% annual species reported in 1983. Desert wheatgrass, intermediate wheatgrass, yellow sweetclover and alfalfa make up 27.2 percent of the 1984 composition. In 1983 these same species accounted for only 9.5% of the relative composition. Based upon the composition data, it is evident the cover of volunteer annual plants is decreasing, while the cover of seeded perennial plants is increasing. Eleven perennial plant species were identified on the topsoil stockpile in the 1984 sampling.

Plant establishment on the subsoil stockpile more than exceeded the original expectation. The overall appearance of the stockpile is good and the plants are vigorous and free from weeds. Erosion features are minimal. Plant cover is 34.45% and current annual production is 495 pounds per acre. In 1984, the plant community is composed of 51% perennial forbs, 39% perennial grasses, and 10% annual forbs. Twelve perennial species were encountered in the cover transect. In comparison, seedling densities reported in 1983 shows 49% perennial grasses, 7% perennial forbs, and 44% annual grains. A complete summary by species is given in Table 5, 1984 Summary of the Topsoil and Subsoil Stockpiles.

WILDLIFE MITIGATION AREA

Description

The Wildlife Mitigation area was treated in the Fall of 1982 in an attempt to improve the site for deer winter range. The anticipated habitat improvement was to help compensate for temporary habitat loss associated with the refuse pile expansion and the unit train facility. Treatments consisted of dozing pinyon and juniper trees that were enchroaching into the big sagebrush community, crushing mature serviceberry shrubs to make

new growth available for deer, seeding with a mixture of grasses, forbs, and shrubs, and transplanting shrub seedlings into the scalps created from the dozing activity. The area was also fertilized with 200 lbs/acre of 16-16-8.

A detailed description of the work that was done and is contained in the 1983 Annual Reclamation Report. A summary is as follows:

SHRUBS TRANSPLANTED ON THE WILDLIFE MITIGATION AREA

SPECIES	NO. PLANTED	SOURCE
Fourwing saltbrush	500	Container
Bitterbrush	1,000	"
Serviceberry	700	"
Currant	300	"
Mormon Tea	500	"
True Mountain Mahogany	500	"

WILDLIFE MITIGATION AREA SEED MIXTURE

	POUNDS LBS/ACRE
Pubescent Wheatgrass	1
Fairway Crested Wheatgrass	1
Russian Wildrye	3
Prostrate Kochia	1
Ladak Alfalfa	3
Pacific Aster	1
Yellow Sweet Clover	1
Blue Flax	1
Desert Globemallow	1
Small Burnet	1
Fourwing Saltbrush	2
	16

During the Fall of 1982, approximately 16 acres of the 40 acre wildlife mitigation area, shown on Plateau Mining Company 1984 Reclamation Map 2, was treated in an attempt to improve the site for deer winter range. The treatments consisted of (1) dozing pinyon and juniper trees that were enchroaching on a big sagebrush community; (2) crushing mature serviceberry shrubs to make new growth available for deer; (3) reseeding with the mixture given on page 6 of this report and fertilizing at 200 lbs/a of 16-16-8; and (4) transplanting shrub seedlings into the scalps and other disturbed areas created by dozing and crushing the pinyon, juniper, and serviceberry trees. Shrub seedings were transplanted in April 1983 at an estimated density of 4,000/acres in the scalps and mechanically disturbed areas. The shrub species transplanted are given on page 6 of this report.

A shrub survival test plot was established at the site using the same plant material transplanted on the rest of the treatment area. Test shrubs were planted in rows with 3' distance separating rows and plants within the rows.

Results and Discussion

Results are summarized in Table 6, 1984 Vegetation Summary of the Wildlife Mitigation Area and Control Area; Table 7, 1984 Shrub Density Summary of the Wildlife Mitigation Area and Control Area; Table 8, 1984 Shrub Survival Test Plots Summary, Wildlife Mitigation Area.

A review of Table 6, 1984 Vegetation Summary reveals the percent cover on the treatment area and the control are to be 32.9% and 34.2. Cover on the treatment area is up 8.3% over 1983 data while the control area cover is down 3.7%. Production is 15.06 g/½m^2 (538 lbs/acre) and 16.54 g/¼m^2 (590 lbs/acre) respectively. Production in 1983 was 326 lbs/acre on the treatment area and 328 lbs/acre on the control area, or about 70% greater in 1984. Both cover and production is slightly higher on the control area, but a two-tail T-Test reveals no significant difference. Woody plant density as shown, on Table 7, 1984 Shrub Density Summary, reveals that shrub density on the treatment area is 10,053 stems per acre compared to

9,000 stems per acre on the control area. However, these densities are not statistically different. In 1983, shrub densities were reported to equal 4,156/acre and 6,155/acre respectively or 32% fewer on the treatment area. With an increase of nearly 142%, shrub density is increasing on the mitigation treatment area. Composition of cover values shows that grass, forbs, and shrubs make up 66%, 8%, and 26% of the treatment area and 43%, 0%, and 57% of the control area. Composition in 1983 as 38%, 20% and 42% respectively on the treatment area and 25%, 6%, and 68% respectively on the control area. Almost 75% (58% in 1983) of the treatment area is composed of herbaceous plants while only 43% (31% in 1983) of the control area are herbaceous. Herbaceous production is 70% (63% in 1983) on the treatment area and 60% (58% in 1983) on the control. There appears to be an obvious shift on the treatment area toward herbaceous species. Shrub production in 1983 was 38% of the total production on the treated area and 39% of the production on the control area. The relative percent of the shrub production remained about the same in 1984 on the control area (40%), but dropped on the treated area (30%). These results support the objectives of the seeding treatment to increase herbaceous forage.

Casual observation made on May 4, 1984 on both the treatment and control area explains the importance of the shift in plant composition toward greater herbecaous production in terms of deer use. It was readily apparent that there were more deer tracks and pellet groups on the treatment area than on the control or adjacent areas. Utilization of the seeded grasses and forbs was extensive while utilization of the native grasses on the control and adjacent areas was minimal. It appears that deer use on the treatment area is greater than the control or surrounding sites and that they are extensively utilizing the seeded species. It is possible that the higher forage quality of the seeded species can partially explain the increased utilization of the treated area. It is also expected that the overall value of the treated area will improve as in terms of forage and browse potential as the seeded species and transplanted shrubs mature.

Table 8, Shrub Survival Test Plots, as shown on Map 2, discloses that of the original six species of shrub seedlings transplanted into the wildlife mitigation area test plots, in the early Spring of 1983, three species have completely died out. Those not surviving the second year are fourwing saltbush, Mormon tea, and true mountain mahogany. Currant has the highest survival with 59% still living, while bitterbrush has 51% and serviceberry has 37%. Bitterbrush was the most vigorous transplanted shrub. Serviceberry survival is up by 14% over last year's data. An additional 7 serviceberry plants were found to be alive that were thought to be dead last year. Some of the serviceberry plants are rosetts of leaves at the base of the dead stem. All three of the surviving species were found to be moderately to heavily browsed.

Quantitative observations on surviving shrub transplants recorded while casually traversing the mitigation area indicates that about 22% are serviceberry, 33% are mountain mahogany, 39% are currant, and 6% are bitterbrush.

BARROW AREA AND OFFICE ROAD CUT STUDY PLOTS

Description

Study plots were installed at the barrow area and the road fill area below the upper office parking lot at the Lion Deck Portion in 1980, as shown on the Reclamation Map. Containerized shrubs were transplanted into the plots April 1981. A complete description of the plots is given in the Star Point Mines' 1983 Annual Reclamation Report submitted in January 1984 by Plateau Mining Company. Data collected in 1984 was restricted to shrub survival, shrub vigor, and average shrub height.

Results and Discussion

A summary of the shrub survival data is presented in Table 9, 1984 Summary of Shrub Survival and the Barrow Area Study Plots and in Table 10, 1984 Summary of Shrub Survival on the Office Road Cut Study Plots. The Barrow Area Study Plots had the highest average shrub survival at 44.9% with a range of 25.0% to 75.0%. However, the average vigor rating is 4.3

on a scale of 1 to 10 with 10 being the best, and an average shrub height of 10.0 cm with a range of 5.3 cm to 13.8 cm. This is compared to a much lower average shrub survival of 19.2% on the Office Road Cut Study Plots where survival ranged from 4.2% to 45.8%. Vigor was much higher on the Office Road Cut area with an average vigor of 7.0; height of the surviving shrubs averaged 22.3 and ranged from an average of 11 cm for gambel oak to an average of 33.9 cm for sagebrush. Differences in the survival rates between these two sites does not reflect the site potential as well as the vigor and height values. The Barrow Area has a tight, heavy textured, surface material, made up of yellow subsoil and weathered shale while the Office Road Cut Area has a course textured soil derived from sandstone material created by the road cut which probably favors infiltration of moisture and root development. Both have east aspects. Survival on the Office Road Cut area appears to be lower due to rock and surface soil movement on the steep slope.

Refuse Pile Vegetation Test Plots

Description

The Refuse Pile Vegetation Test Plots was implemented in the field during the Fall of 1982. Four soil treatments including (1) topsoil; (2) subsoil; (3) a combination of 10 inches of topsoil over 10 inches of subsoil; (4) coal waste which is produced in the coal wash plant. Topsoil and subsoil was applied at 10 inch and 20 inch depths over the coal waste material. All plots were divided into two fertilizer rate treatments (100 and 200 lbs/a of 16-16-8) which were further segregated into three slope categories as specified by the Division in their August 1, 1984 memo to Coal File (see Exhibit A). The categories are: upper 1/3, middle 1/3, and lower 1/3 of the slope. Soil material, soil depth and fertilizer treatments extend the entire length of the slope. A review of the procedures is presented in Exhibit C, Refuse Pile Vegetation Test Plot Design.

Study objectives are to determine which is the most practical combination of soil material and soil depth that would yield acceptable revegetation in terms of cover, production, and woody plan densities. A fertilizer rate of 100 pounds per acre of 16-16-8 is the minimum amount to be applied while reclaiming the site and represents the control treatment for the study.

A complete description of the Refuse Pile Research Study and the first year's data is given in Star Point Mine 1983 Reclamation Report submitted by Plateau Mining Company in January, 1984. The slope factor was included as an addition to the 1984 sampling scheme suggested by the Division. Additional information including the addition of slope as a factor, was presented in Plateau Mining Company's June 21, 1984 response to Special Stipulation No. 6, Refuse Pile Research Plots. A copy of this response is given in Exhibit C, Refuse Pile Vegetation Test Plot Design.

Results of the Analysis of Variance and the Duncan Multiple Range Test for cover, production, shrub density, and production by life form is given in Table 11, 1984 Statistical Summary of the Refuse Pile Vegetation Test Plots. A breakdown of the cover data by species is presented in Table 12, 1984 Summary of Percent Cover and Relative Percent composition by species.

Statistically significant differences exist between soil materials and soil material by depth for all plant parameters. Fertilizer rate had no effect on plant cover, but fertilizer at a rate of 200 lbs/acre produced higher amounts of herbaceous forage, but the 100 lbs/acre fertilizer rate resulted in significantly higher shrub-densities. Depth of respeard soil material as an independent factor showed no differences in cover or production, but plots with 10 inches of either topsoil or subsoil material produced significantly more shrubs than the 20 inch depth plots. The effect of slope appear slight for plant cover with a difference between the upper 1/3 and the lower 1/3, but not between the upper 1/3 and the middle 1/3, nor between the middle 1/3 and the lower 1/3. There is no difference

in plant production due to slope, but the shrub densities are higher on the middle 1/3. Shrub densities are not different between the middle 1/3 and the lower 1/3.

Coal refuse is significantly lower for all plant parameters except for the production of annual weeds which is not different from that of topsoil, but is significantly higher than weed production on the subsoil treatments.

Total plant cover on subsoil is significantly lower than topsoil and the topsoil/subsoil treatments with 16.02% compared to 18.84 and 18.81 respectively. Further analysis which contrast soil material and depth identifies the difference in cover to be attributed to 20" subsoil which is statistically lower than all other soil-depth combinations.

Plant production is greatest on the topsoil/subsoil treatment. It produced 10.13 g/¼m^2 (362 lbs/acre) while topsoil alone produced 8.12 g/¼m^2 (290 lbs/a) and subsoil alone produced 8.55 g/¼m^2 (305 lbs/a). When the soil-depth combinations were contrasted by production by life form, it revealed that there is no difference in the production of perennial grasses between the topsoil/subsoil treatment with 6.54 g/¼m^2 (233 lbs/acre) and the 20" subsoil material with 6.39 g/¼m^2 (228 lbs/acre) or the 10" subsoil material with 6.69 g/¼m^2 (239 lbs/acre). Perennial grass production for 10" and 20" topsoil is significantly lower than all other soil-depth combinations. The 10" topsoil produced 4.32 g/¼m^2 (154 lbs/acre) of perennial grasses and 20" topsoil produced 3.87 g/¼m^2 (138 lbs/acre). Forb production varied very little between soil-depth combinations; however, the production of annual weeds was significantly higher on topsoil and topsoil/subsoil treatments. Topsoil production is composed of 45% weeds, topsoil/subsoil is 27% weeds while subsoil is 19% weeds.

Woody plant density is significantly greater on the subsoil treatment than on other treatments. The comparison of soil-depth combinations reveals no difference in shrub densities on 20" topsoil, 10" topsoil, 20" subsoil, and topsoil/subsoil. Shrub densities on these treatments range

from 720 shrubs per acre (2.48 stems/150 ft.^{2}) to 961 shrubs per acre (3.31 stems/150 ft.^{2}). Subsoil has significantly more shrubs which is attributed to the 10" subsoil treatment which has almost 3 times that of the other treatments at 2,198 shrubs per acre (7.57 stems/150 ft.^{2}).

Species compostition was calculated from the plant cover data. The dominant seeded species are western wheatgrass, slender wheatgrass, tall fescue, and yellow sweetclover. All topsoil treatments have a preponderance of cheatgrass and annual weedy forbs. The composition on the 20" topsoil treatment is 26.5% cheatgrass and 35.0% annual forbs while the 10" topsoil treatment has 47.7% cheatgrass and 21.4% annual forbs. Subsoil treatments have less than 0.1% cheatgrass while annual forbs make 30.5% of the 10" subsoil treatment and 14.8% of the 20" subsoil treatment. Fourwing saltbush, rabbitbrush, and green ephedra shrubs are most prevalent on the 10" topsoil and the 10" subsoil treatments where shrubs composed of 1.8% and 2.8% respectively.

Conclusion

Significant differences exist between soil material treatments. Fertilizer treatments were different for production and shrub density, but not for cover. Depth is significant only for shrub density. Slope appears to have only a slight effect on cover and shrub density, but not on production. Coal waste is significantly lower for all parameters on all treatments. It should be noted that the plants growing on coal waste are as vigorous as and in some cases more vigorous than plants growing on the topsoil and subsoil.

Subsoil material has the highest perennial plant production, cover and woody plant densities. Topsoil has the highest cheatgrass and annual weed composition. Shrub cover is the highest on 10" subsoil and 10" topsoil. Species diversity is about equal for all treatments. 20" subsoil and coal waste have the lowest number of species.

Overall performance is best on the 10" subsoil treatments in terms of perennial plant cover, production, and shrub density. It contains 15 plant species, three of which are shrubs. Based on perennial plant establishment, the 20" subsoil treatments are next to the 10" subsoil treatments followed by the topsoil/subsoil treatment and lastly, by the topsoil treatments.

No recommendations are being made at this point, but the trend from the 1983 and 1984 data favors the subsoil material as the most acceptable plant growth medium. Specifically, the 10" subsoil treatment most closely meets the research study objectives as the most practical combination of soil material and depth with regard to revegetation success standards.

Similarity on Plots Which Will Be Disturbed in 1985

In anticipation of the fact that portions of the 20" subsoil treatment and the topsoil-over-subsoil treatment will be disturbed by the unit-train conveyor systems after the third year of data collection in 1985, the following discussion is made to establish preliminary trends in similarity between these treatments and the reamining undisturbed treatments. The Division agreed in their Memo To Coal File, dated August 1, 1984 and presented in Exhibit A for convenience of reference, that the long term effects of the underlying refuse material on plant establishment may not be too evident from the first three years of data. However, if the first three years of data indicate similarity between the disturbed treatments and the remaining undisturbed portions and other closely related treatments, then the long range effects of coal refuse on plant establishment can be made from the undisturbed areas and treatments and it will not be necessary to redo the disturbed plots. Table 11, 1984 Statistical Summary, provides the statistical comparisons of the treatments.

One of the treatments that will be disturbed is the topsoil-over-subsoil treatment. Since less than one-half of the topsoil-over-subsoil

treatment will be disturbed, the remaining undisturbed area should be adequate for monitoring long range effects of the coal refuse material on plant establishment for this treatment.

The other treatment to be disturbed is the 20" subsoil treatment. both the 10" subsoil and the remaining undisturbed portions of the topsoil-over-subsoil treatment as well as the small undisturbed area of the 20" subsoil treatment should provide sufficient similarity to enable long range monitoring of the plant responses to the coal refuse material. The 10" subsoil treatment has statistically comparable production (8.76 g/¼m^2) with significantly greater cover (17.60% vs. 14.50%) and shrub density (7.57 stems/150 m^2 vs. 2.46 stems/150 m^2). The topsoil-over-subsoil treatment has consistantly higher values for production (10.77 g/¼m^2 vs. 8.36), cover (19.08% vs. 14.50%), and shrub density (3.4 stems/150 m^2) vs. 2.48 stems/150 m^2). Even though second year data from undisturbed plots are not identical to the 20" subsoil treatment, there appears to be enough similarity to measure long term plant establishment.

TABLE 1

1984 SUMMARY OF REVEGETATION DATA ON RESEEDED SITES

SITE	COVER (%)	PRODUCTION (lbs/acre)	SHRUB DENSITY (#/acre)	SEEDLING DENSITY (#/ft^2)
1980 Seeding	12.13	1,236	183	-
1981 Seeding	22.83	1,906	789	-
1983 Seeding	-	-		2.27
Topsoil Stockpile	54.40	1,688	-	-
Subsoil Stockpile	34.45	495	-	4.56*

*1983 Subsoil Stockpile Seeding Perennial Plant Seedling.

Cover and production data is from 1983 reclamation.

TABLE 2

1984 SUMMARY OF THE 1980 RECLAMATION

	% COVER	% COMPOSITION	PRODUCTION	SHRUB DENSITY
GRASSES				
Desert Wheatgrass	1.14	9.0	-	-
Intermediate Wheatgrass	3.45	28.0	-	-
Slender Wheatgrass	0.09	1.0	-	-
Smooth Brome	0.70	1.0	-	-
Mountain Brome	0.01	0.1	-	-
Orchardgrass	0.41	3.0	-	-
Russian Wildrye	0.01	0.1	-	-
Salina Wildrye	1.26	10.0	-	-
Indian Ricegrass	0.01	0.1	-	-
Bluegrass	0.07	1.0	-	-
Timothy	0.02	0.2	-	-
FORBS				
Aster	0.28	2.0	-	-
Yellow Sweetclover	1.50	12.0	-	-
Alfalfa	2.64	22.0	-	-
Oyster Plant	0.01	0.1	-	-
Annuals	0.07	1.0	-	-
Russian Thistle	0.01	0.1	-	-
SHRUBS				
Sagebrush	0.01	0.1	-	64/acre
Rabbitbrush	0.01	0.1	-	-
Mountain Mahogany	0.00	0.0	-	19/acre
Eriogonum	0.43	4.0	-	100/acre
TOTAL	12.13	94.9	1,236 lbs/acre	183/acre

TABLE 3

1984 SUMMARY OF THE 1981 RECLAMATION

	% COVER	% COMPOSITION	PRODUCTION	SHRUB DENSITY
GRASSES				
Desert Wheatgrass	0.90	4.0	-	-
Intermediate Wheatgrass	7.08	31.0	-	-
Slender Wheatgrass	0.19	0.8	-	-
Smooth Brome	0.96	4.2	-	-
Mountain Brome	0.07	0.3	-	-
Orchardgrass	0.36	1.6	-	-
Salina Wildrye	0.45	2.0	-	-
Indian Ricegrass	0.12	0.5	-	-
Bluegrass	0.02	0.1	-	-
FORBS				
Cicer Milkvetch	0.09	0.4	-	-
Yellow Sweetclover	3.33	14.6	-	-
Alfalfa	8.34	36.5	-	-
Russian Thistle	0.59	2.6	-	-
SHRUBS				
Sagebrush	-	-	-	77/acre
Four-wing Saltbush	0.33	1.4	-	624/acre
Rabbitbrush	-	-	-	43/acre
Potentilla	-	-	-	5/acre
Bitterbrush	-	-	-	15/acre
Rose	-	-	-	10/acre
Elderberry	-	-	-	10/acre
Snowberry	-	-	-	5/acre
TOTAL	22.83	100.0	1,906 lbs/acre	789/acre

TABLE 4

SUMMARY OF THE 1983 SEEDINGS

SITE	SEEDLINGS PER SQUARE FOOT			
	PERENNIAL GRASS	PERENNIAL FORBS	ANNUALS	TOTAL
1983 Reclamation Seedings	1.25	0.05	0.97	2.27
1983 Subsoil Stockpile Seeding	2.65	1.35	0.56	4.56

TABLE 5

1984 SUMMARY OF THE TOPSOIL AND SUBSOIL STOCKPILES

	TOPSOIL STOCKPILE		SUBSOIL STOCKPILE	
	% COVER	% COMPOSITION	% COVER	% COMPOSITION
GRASSES				
Desert Wheatgrass	4.80	8.82	4.91	14.25
Intermediate Wheatgrass	5.00	9.19	3.82	11.09
Slender Wheatgrass	0.40	0.74	0.09	0.26
Smooth Brome	0.40	0.74	0.82	2.38
Cheatgrass	2.40	4.41	-	-
Orchardgrass	0.20	0.37	2.27	6.59
Russian Wildrye	0.20	0.37	0.27	0.78
Fescue	0.20	0.37	0.45	1.31
Indian Ricegrass	-	-	0.64	1.86
Squirreltail	1.20	2.21	0.27	0.78
FORBS				
Yellow Sweetclover	3.20	5.88	2.73	5.81
Alfalfa	1.80	3.31	15.45	44.85
Annuals	34.20	62.87	2.64	9.78
SHRUBS				
Sagebrush	0.40	0.74	-	-
Rabbitbrush	-	-	0.09	0.26
TOTAL	54.4	100.0	34.45	100.00
TOTAL PRODUCTION:	1,688 lbs/acre		495 lbs/acre	

TABLE 6

1984 VEGETATION SUMMARY

WILDLIFE MITIGATION AREA AND CONTROL AREA

SPECIES	% COVER		PRODUCTION ($g/\frac{1}{4}m^2$)	
	TREATMENT	CONTROL	TREATMENT	CONTROL
Wheatgrasses	9.7	-	-	-
Crested Wheatgrass	3.6	-	-	-
Pubescent Wheatgrass	0.2	-	-	-
Bluebunch Wheatgrass	-	5.5	-	-
Blue Gramma	6.2	6.7	-	-
Cheatgrass	0.1	-	-	-
Indian Ricegrass	0.3	1.5	-	-
Squirreltail	1.6	0.8	-	-
Needlegrass	0.1	0.1	-	-
Subtotal	21.8	14.6	8.79	9.01
FORBS				
Buckwheat	0.2	-	-	-
Wild Lettuce	0.1	-	-	-
Blue Flax	0.2	-	-	-
Yellow Sweetclover	0.4	-	-	-
Globe Mallow	1.7	-	-	-
Subtotal	2.6	0.0	1.69	0.93
SHRUBS				
Serviceberry	0.2	0.4	-	-
Sagebrush	7.4	18.5	-	-
Rabbitbrush	0.9	0.4	-	-
Pinyon Pine	-	0.3	-	-
Subtotal	8.5	19.6	4.58	6.60
TOTAL	32.9	34.2	15.06	16.54

TABLE 7

1984 SHRUB DENSITY SUMMARY

WILDLIFE MITIGATION AREA AND CONTROL AREA

	SHRUBS PER ACRE	
SPECIES	TREATMENT AREA	CONTROL AREA
Serviceberry	316	450
Fringed Sage	53	-
Sagebrush	9,368	7,950
Rabbitbrush	-	50
Pinyon Pine	316	550
TOTAL	10,053	9,000

TABLE 8

1984 SHRUB SURVIVAL TEST PLOTS SUMMARY

WILDLIFE MITIGATION AREA

SPECIES	PERCENT SURVIVAL	VIGOR (1-10)***	AVERAGE HEIGHT (cm)
Currant	59	4	10.1
Bitterbrush	51	7	8.8
Serviceberry	37**	5	5.0
Fourwing Saltbush*	0	0	0.0
Mormon Tea*	0	0	0.0
True Mtn. Mahogany*	0	0	0.0

*No live plants observed in the test plots.

**7 more serviceberry plants that were thought to be dead last year were found alive this year which inceased survival from 23 to 37%.

***Vigor rating from 1 to 10 with 10 being the most vigorous.

TABLE 9

1984 SUMMARY OF SHRUB SURVIVAL

ON THE BARROW AREA STUDY PLOTS

SPECIES	% SURVIVAL	VIGOR (1-10)	HEIGHT (cm)
Serviceberry	33.3	2.5	5.3
Black Sagebrush	33.3	5.5	10.3
Fourwing Saltbush	41.7	4.8	11.6
Peashrub	75.0	5.3	11.9
Curleaf Mtn. Mahogany	50.0	4.2	7.0
True Mtn. Mahogany	25.0	4.8	7.0
Rabbitbrush	41.7	4.7	13.4
Rocky Mtn. Juniper	70.8	3.2	10.1
Gambel Oak	33.3	3.3	13.8
	44.9	4.3	10.0

TABLE 10

1984 SUMMARY OF SHRUB SURVIVAL

ON THE OFFICE ROAD CUT STUDY PLOTS

SPECIES	% SURVIVAL	VIGOR (1-10)	HEIGHT (cm)
Big Sagebrush	45.8	9.1	33.9
Gambel Oak	8.3	4.0	11.0
Fourwing Saltbrush	20.8	9.1	32.8
Rabbitbush	20.8	8.4	25.6
Oak Sumac	12.5	6.0	13.0
Utah Serviceberry	4.2	5.0	28.0
Curleaf Mtn. Mahogany	8.3	7.0	19.25
True Mtn. Mahogany	29.2	8.4	21.4
Rocky Mtn. Juniper	10.4	6.4	15.6
	19.2	7.0	22.3

*The most vigorous received a rating of 10, the least a value of 1.

TABLE 11

1984 STATISTICAL SUMMARY OF THE REFUSE PILE VEGETATION TEST PLOTS

TREATMENT	% COVER	PRODUCTION ($g/\frac{1}{4}m^2$)	SHRUB DENSITY (#/150 ft^2)
SOIL MATERIAL			
Topsoil	18.84 A*	8.12 B*	2.63 B*
Subsoil	16.02 B	8.55 B	4.91 A
10" Top/10" Sub	18.81 A	10.13 A	3.31 B
Coal Waste	7.36 C	4.13 C	1.32 C
SOIL DEPTH			
20" Topsoil	18.86 A	8.36 B	2.70 B
10" Topsoil	18.77 A	7.69 B	2.50 B
10" Subsoil	17.68 A	8.76 B	7.57 A
20" Subsoil	14.50 B	8.36 B	2.48 B
10" Top/10" Sub	18.81 A	10.13 A	3.31 B
Coal Waste	7.36 C	4.13 C	1.32 C
**FERTILIZER			
100 lbs/acre	17.12 A	8.34 B	4.45 A
200 lbs/acre	17.93 A	9.19 A	3.30 B
**DEPTH			
10"	18.05 A	8.98 A	5.88 A
20"	17.31 A	8.40 A	2.84 B
**SLOPE			
Upper 1/3	18.67 A	9.14 A	3.28 B
Middle 1/3	17.18 AB	8.40 A	4.44 A
Lower 1/3	16.39 B	8.82 A	3.81 AB

*Values with the same letter are not statistically different. Where an A and a B are associated with the same value, the value is not statistically different from other values with an A or a B or both an A and B.

TABLE 11

1984 STATISTICAL SUMMARY OF THE REFUSE PILE VEGETATION TEST PLOTS

(Cont'd)

TREATMENT	PERENNIAL GRASSES ($g/\frac{1}{4}m^2$)	PERENNIAL FORBS ($g/\frac{1}{4}m^2$)	ANNUALS ($g/\frac{1}{4}m^2$)
Topsoil	4.03 B	0.41 B	3.62 A
Subsoil	6.84 A	0.50 B	1.59 B
10" Top/10" Sub	6.55 A	0.86 A	2.73 A
Coal Waste	0.60 C	0.21 C	3.32 A
SOIL DEPTH			
20" Topsoil	3.87 B	0.41 B	4.07 A
10" Topsoil	4.32 B	0.39 B	2.98 AB
10" Subsoil	6.69 A	0.37 B	1.70 BC
20" Subsoil	6.39 A	0.66 AB	1.31 C
10" Top/10" Sub	6.54 A	0.86 A	2.73 AB
Coal Waste	0.60 C	0.21 C	3.32 AB
**FERTILIZER			
100 lbs/acre	6.03 A	0.56 A	2.12 A
200 lbs/acre	5.94	0.54 A	2.70 A
**DEPTH			
10"	6.44 A	0.38 B	2.06 A
20"	5.71 A	0.66 A	2.62 A
**SLOPE			
Upper 1/3	6.25 A	0.53 B	2.33 A
Middle 1/3	5.79 A	0.28 B	2.79 A
Lower 1/3	5.85 A	1.00 A	1.97 A

**Since coal waste is significantly lower for cover, production and shrub density, it was deleted for the analysis of these variables. Analysis of these treatments was performed on topsoil and subsoil materials only.

TABLE 12

1984 SUMMARY OF PERCENT COVER AND RELATIVE COMPOSITION BY SPECIES
REFUSE PILE VEGETATION TEST PLOTS

	20" TOPSOIL		10" TOPSOIL	
SPECIES	% COVER	% COMP	% COVER	% COMP
GRASSES				
Crested Wheatgrass	0.05	0.3	0.23	1.2
Intermediate Wheatgrass	-	-	-	-
Western Wheatgrass	2.40	12.7	1.86	9.9
Slender Wheatgrass	0.93	4.9	0.73	3.9
Basin Wildrye	0.23	1.2	0.05	0.3
Tall Fescue	1.85	9.8	1.59	8.5
Indian Ricegrass	-	-	0.10	0.5
Squirreltail	0.33	1.7	0.23	1.2
Orchardgrass	-	-	-	-
Cheatgrass	5.00	26.5	8.95	47.7
SUBTOTAL	10.79	57.0	13.59	72.2
FORBS				
Cicer Milkvetch	0.38	2.0	0.27	1.4
Yellow Sweetclover	0.78	4.2	0.41	2.2
Penstemon	0.05	0.3	-	-
Gumweed	0.18	1.0	0.18	1.0
Annuals	6.60	35.0	4.00	21.4
SUBTOTAL	7.99	42.5	4.86	26.0
SHRUBS				
Fourwing Saltbush	0.05	0.3	0.09	0.5
Rabbitbrush	-	-	0.14	0.8
Green Ephedra	0.03	0.2	0.09	0.5
SUBTOTAL	0.08	0.5	0.32	1.8
TOTAL	18.86	100.0	18.77	100.0

TABLE 12

1984 SUMMARY OF PERCENT COVER AND RELATIVE COMPOSITION BY SPECIES

REFUSE PILE VEGETATION TEST PLOTS

(Cont'd)

	10" SUBSOIL		20" SUBSOIL	
SPECIES	% COVER	% COMP	% COVER	% COMP
GRASSES				
Crested Wheatgrass	0.23	1.3	0.06	0.4
Intermediate Wheatgrass	-	-	-	-
Western Wheatgrass	5.26	29.8	5.69	39.3
Slender Wheatgrass	1.73	9.8	1.23	8.5
Basin Wildrye	0.77	4.4	0.26	1.8
Tall Fescue	2.65	15.0	2.13	14.6
Indian Ricegrass	0.02	0.1	-	-
Squirreltail	0.14	0.8	-	-
Orchardgrass	-	-	-	-
Cheatgrass	0.02	0.1	-	-
SUBTOTAL	0.83	61.3	9.37	64.6
FORBS				
Cicer Milkvetch	0.39	2.2	1.08	7.4
Yellow Sweetclover	0.52	2.9	1.85	12.8
Penstemon	0.05	0.3	-	-
Gumweed	-	-	-	-
Annuals	5.39	30.5	2.14	14.8
SUBTOTAL	6.35	35.9	5.07	35.0
SHRUBS				
Fourwing Saltbush	0.18	1.0	0.06	0.4
Rabbitbrush	0.25	1.4	-	-
Green Ephedra	0.07	0.4	-	-
SUBTOTAL	0.50	2.8	0.06	0.4
TOTAL	17.68	100.0	14.50	100.0

TABLE 12

1984 SUMMARY OF PERCENT COVER AND RELATIVE COMPOSITION BY SPECIES

REFUSE PILE VEGETATION TEST PLOTS

(Cont'd)

	10" TOP/10" SUB		COAL WASTE	
SPECIES	% COVER	% COMP	% COVER	% COMP
GRASSES				
Crested Wheatgrass	0.13	0.7	-	-
Intermediate Wheatgrass	-	-	0.04	0.5
Western Wheatgrass	3.79	20.1	0.50	6.9
Slender Wheatgrass	1.77	9.3	-	-
Basin Wildrye	0.88	4.7	0.04	0.5
Tall Fescue	2.63	14.0	0.25	3.4
Indian Ricegrass	0.02	0.1	-	-
Squirreltail	0.19	1.0	-	-
Orchardgrass	0.02	0.1	-	-
Cheatgrass	0.21	1.1	-	-
SUBTOTAL	9.66	51.2	0.83	11.3
FORBS				
Cicer Milkvetch	0.75	4.0	0.54	7.3
Yellow Sweetclover	0.94	5.0	1.04	14.1
Penstemon	-	-	-	-
Gumweed	0.52	2.8	-	-
Annuals	6.88	36.6	4.95	67.3
SUBTOTAL	9.11	48.4	6.53	88.7
SHRUBS				
Fourwing Saltbush	0.04	0.2	-	-
Rabbitbrush	0.04	0.2	-	-
Green Ephedra	-	-	-	-
SUBTOTAL	0.08	0.4	0.00	0.0
TOTAL	18.81	100.0	7.36	100.0

EXHIBIT A

UTAH DIVISION OF OIL, GAS AND MINING

Memo to Coal File

Refuse Pile Research Study Approval

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

4241 State Office Building • Salt Lake City, UT 84114 • 801-533-5771

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Dianne R. Nielson, Ph.D., Division Director

August 1, 1984

TO: Memo to Coal File

FROM: Lynn Kunzler, Reclamation Biologist

RE: Refuse pile test plots and Unit Train Revision, Plateau Mining Company, ACT/007/006, Carbon County, Utah

On July 25, 1984, Lynn Kunzler and Tom Portle of the Division met on-site with Clem Parkin of Getty Oil and Ben Grimes of Plateau to review the refuse pile test plots and asertain impacts to said test plots due to anticipated installation of the proposed Unit Train Loadout facilities and observe the effectiveness of wildlife mitigation that has been implemented.

Test Plots

Resolved: Plateau will not disturb the test plots until after 1985 data is collected, thus providing three full years of data from all plots. After installation of the proposed Unit Train facilities, most of plots B2 (20" subsoil w/100 lbs/acre 16-16-8 fertilizer) and C1 (10" subsoil w/100 lbs/acre 16-16-8 fertilizer) and about 1/2 of plots B1 and C2 (soils same as B2 and C1, fertilizer rate doubled) will be destroyed.

It was decied that three years of data should be sufficient to determine the effects of the fertilzer rate and soil/subsoil depth on initial establishment. However, three years is not adequate to determine the long range establishment or the possible effects of the underlying refuse material. It may be possible to obtain sufficient data form the remaining portions of plots B1 and C2, however, if data from each plot differs significantly from closely related plots or varies greatly year to year, it may be necessary to redo test plots for the affected treatments. The division will make ths determination after reviewing the 1985 data.

Sampling proceedures for the test plots will include:

Cover - a tenpoint frame will be located along 9, 50' transects in each subplot (each plot being divided into three subplots - upper slope, mid slope and lower slope and each subplot being divided into three replecations). Each sample unit will consist of 100 pins.

Production - herbaceous (grass and forb) species will be clipped in 3, 1/4m^2 quadrates along each cover transect.

Density - a meter-wide belt transect along each cover transect will be utilized to determine woody plant density

These sampling proceedures are acceptable to the Division and should provide adequate data for statistical analysis.

Unit Train

Wildlife Mitigation

Background: In 1982, Plateau Mining Company initiated enhancement of a 40 acre tract of land in critical winter habitat. Enhancement activities included removal of overmature woody vegetation by blading and disking to promote sprouting, seeding with species of known food value for wildlife and building small catchment basins in an ephemoral drainage. Within a few months of completion, the catchment basins had silted in. Rather than a continued maintenance program, a guzzler is being installed to replace the catchment basin in the spring and summer of 1984.

Observations and Discussion: Brush piles as a result of the blading were scatered throughout the area, providing habitat for small mammals, most of the seeded grass and forb species were doing well and were in abundance. Transplanted browse species were also doing well. One species of particular concern as to how well it was performing was kochia prostrata (an introduced species). Discussions with Clem Parkin indicated that it had been seeded, but no specimens had been found. After transversing the area twice looking for this species, one plant was finally located. The plant was less than six inches high and had been heavily browsed. Surveys to quantify the vegetation response will be done in the next two weeks.

The guzzler installation was nearly complete and had a three-wire (barbed) fence around it to prevent use by cattle. Although there was about six inches of water in the guzzler, there was no physical evidence that it was being used. This is probably due in part to an abnormally wet year with water readily available throughout the general vicinity and construction/installation activities were still being finished. Vegetation was sparse within several feet of the guzzler and could also be a contributing factor to its low use. This could be remedied by planting/seeding species to provide hiding cover around the guzzler.

Conclusion: At this point in time, the enhancement activities could be considered a success in increasing the carrying capacity and improving habitat conditions to absorb wildlife displaced by the proposed Unit Train facilities and the waste pile expansion. Continued monitoring of the site will demonstrate the level of enhancement achieved.

LK:grc
cc: Allen Klein, OSM
Ben Grimes, Plateau Mining Company
Clem Parkin, Getty Oil Company
Sue Linner, DOGM
Tom Portle, DOGM
Dave Lof, DOGM

97380-5-7

EXHIBIT B

SEED MIXTURES USED AT PLATEAU MINING COMPANY

1980 SEED MIXTURE

	% MIXTURE
Russian Wildrye	15%
Streambank Wheatgrass	11%
Mountain Brome	5%
Big Sage Brush	5%
Fourwing Saltbush	8%
Western Wheatgrass	15%
Pubescent Wheatgrass	15%
Indian Ricegrass	5%
Rabbitbrush	3%
Alfalfa "Ranger"	10%
Yellow Sweetclover	10%

1981-1983 SEED MIXTURE

	POUNDS PLS/A
Pubescent Wheatgrass	3
Smooth Brome	3
Alsike Clover	1
Ladak Alfalfa	2
Great Basin Wildrye	1
Fourwing Saltbrush	2
Shadscale	1
Cicer Milkvetch	1
Rubber Rabbitbrush	0.25

REFUSE PILE RESEARCH STUDY SEED MIXTURE

	POUNDS PLS/A
Slender Wheatgrass	3.0
Western Wheatgrass	3.0
Tall Fescue	2.0
G.B. Wildrye	3.0
Blue Bunch Wheatgrass	3.0
Scarlet Globemallow	0.5
Penstemon	0.5
Cicer Milkvetch	1.0
Yellow Sweetclover	1.0
Rubber Rabbitbrush	0.5
Big Sagebrush	0.1
Green Ephedra	2.0
Four Wing Saltbrush	1.0
TOTAL	20.6

SUBSOIL AND TOPSOIL STOCKPILE SEED MIXTURE

	PLS/ACRE
GRASSES	
Fairway Crested Wheatgrass	2
Smooth Brome (Southern Strains)	2
Intermediate Wheatgrass	2
Pubescent Wheatgrass	2
Bluestem Wheatgrass	2
Orchardgrass	2
Russian Wildrye	2
Sandbury Bluegrass	2
Subtotal	16
FORBS	
Alfalfa (Nomad)	2
Ladak - Equal Parts	2
Yellow Sweetclover	2
Subtotal	6
TOTAL PERENNIALS	22
COVER CROP	
Barley and Oats	20
OVERALL TOTAL	42

WILDLIFE MITIGATION AREA SEED MIXTURE

	POUNDS LBS/ACRE
Pubescent Wheatgrass	1
Fairway Crested Wheatgrass	1
Russian Wildrye	3
Prostrat Kochia	1
Ladak Alfalfa	3
Pacific Aster	1
Yellow Sweet Clover	1
Blue Flax	1
Desert Globemallow	1
Small Burnet	1
Fourwing Saltbrush	2
	16

EXHIBIT C

REFUSE PILE VEGETATION TEST PLOTS

Submitted June 21, 1984

In Partial Response to Special Stipulation No. 6

REFUSE PILE RESEARCH STUDY

INTRODUCTION

Reclamation and revegetation of the Refuse Pile was first discussed in the Star Point Mine's Mining and Reclamation Plan, ACT/007/006, Volume IV, submitted February 20, 1981. The reclamation plan called for 10" of topsoil to be respread over the regraded coal waste and reseeded to a perennial seed mixture. The revegetation methods were not proposed in the permit application pending the collection and analysis of the 1981 vegetation field data. During the interim, Plateau Mining Company (PMC) submitted a right-of-way application with the Bureau of Land Management (BLM) to locate a portion of the coal waste pile on public land. Following an environmental assessment, the BLM requested in an August 21, 1981 letter to the Utah Division of Oil, Gas and Mining (the Division) that the Division attach a list of various terms and conditions to the Plateau Mining and Reclamation Plan. One of the BLM's concerns was the reclamation potential of the site. The stipulations proposed by the BLM requested that the coal waste be analyzed to determine if the material contained any elements which could cause plant growth problems and that a seed mixture be developed based on test plots results. On October 14, 1981, Plateau Mining Company was issued a right-of-way grant No. U-47965. Before the issuing of the BLM right-of-way grant, the Division gave approval for the refuse waste pile on October 1, 1981. The approval was given with construction and reclamation plan stipulations. Also stated in the letter was the statement that approximately 10 inches of topsoil would be redistributed and that a final seed mixture would be proposed following completion of the vegetation surveys. The Division Stipulation No. 9-22-1 states that the terms and conditions set forth by the BLM be fulfilled. In stipulation 9-22-4, PMC was asked to submit the results of the revegetation test plots and discuss how these results would apply to the permanent revegetation plan. Responses to the stipulations were made by Plateau Mining Company on November 17, 1981.

Plateau Mining Company's written response to the stipulations in the November 17, 1981 letter to the Division contained an Interim Refuse Pile Reclamation Plan. It provided for the replacement of 10 inches of topsoil, hydroseeding, and an organic wood fiber hydromulch. Selected areas would also receive the implantation of clumps of transplanted vegetation and the hand planting of nursery stock. The proposed seed mixture, which was recommended by the Utah Division of Wildlife Resources, contained 8 grasses, 5 forbs, and 4 shrub species at a rate of 20.5/lbs/acre. In a PMC letter dated May 28, 1982, a minor modification of the Refuse Pile Expansion Plan was requested. The basis for the request was an overestimation of the topsoil available for reclamation. As part of the proposed minor revision, PMC requested that the Division and PMC cooperate in implementing a number of test plots, originally proposed by the BLM, on the existing refuse pile. The purpose of the test plots was to gain insight into the methods and procedures, including topsoil depths, necessary for revegetation. The proposed reclamation plan called for a three phase program. The first step was to revegetate the site using a hydromulch system. A seed mixture consisting of 8 grasses and three forb species was proposed, to be applied at 22 lbs/acre, plus 20 lbs/acre of a cereal grain cover crop. Fertilizer (16-16-8) was to be applied at 200 lbs/acre. Secondly, depressions were to be gouged into the surface to provide for water retention and to help control surface soil erosion. The third phase consisted of excavating clumps of existing vegetation with a front-end loader and transplanting the clumps onto the site. These proposed activities were to have been completed by the fall of 1982. Subsequent vegetation monitoring was to begin in the Summer of 1983.

As a result of the request for input from the Division into the test plot design, Thomas L. Portle, Reclamation Soil Specialist, responded by letter on June 2, 1982 with recommendations for treatments and experimental design. The objective of the proposed study design was to satisfy the requirements of Stipulation 9-22-3 and Stipulation #6. Specifically, the test plots were to help determine the level of fertility amendments to be used in conjunction with topsoil and subsoil depths which would meet the revegetation success standards. The results of the study were also to be used to evaluate excess soil substitute material for reclamation needs at other sites on the mine property and the most

economical usage of the material. Plot dimensions were to be 10 x 10 feet with 2 foot buffer strips set up in a split-plot design with 4 replications. Treatments were to be soil materials, depth of soil material, and fertilizer rates. Soil materials and depths were for both subsoil and topsoil at 5, 10, and 20 inch depths, and topsoil over subsoil at 2 and 5 inches of topsoil over 5, 10, 15, and 18 inches of subsoil. Fertility treatments were 200 lbs/acre and 100 lbs/acre of 16-16-8, 200 tons/acre of sewage sludge, and a control with no fertility amendments. It appears that in order to tie the research study to the implementation of a feasible reclamation project, it was proposed that the minimum depth of the soil material be within the capability of the equipment to distribute it accurately. Also that the soil material or combination of soil materials should not exceed a total depth of 20 inches.

Further comment on the study plots was contained in the Division's June 9, 1982 response to the adequacy of PMC's November 17, 1981 reply to the special stipulations. It was pointed out that PMC had failed to provide soil depth requirements relative to site-specific reclamation needs. In view of the proposed study plots, PMC was asked to identify specific data needs which would be satisfied by the proposed test plots as well as data needs which would not be addressed by the test plots. A compliance schedule for data aquisition and submission of the results was to be provided by PMC. PMC responded to these questions on August 18, 1982, stating that the purpose of the test plots was to determine the effect of fertilizer on germination and growth, the suitability of the seed mixture being used at PMC, the best soil depths for topsoil and subsoil material, and the reclamation methods for other disturbed areas. Future needs were said to be the long term affect of stockpiled topsoil, the best seeding rates, the proper rhizobuim strain to be used with the legume species being planted, and the germination and plant establishment on topsoil from different soil types. The Division's response to the August 18, 1982 letter was that PMC had not utilized all of the test plot conditions cited in the June 2, 1982 Division test plot recommendation letter and that an account of what was implemented in the field was not forwarded to the Division. Consequently, in a August 16, 1983 letter, the Division required that PMC provide a full account of

exactly what was implemented, data on 1983 germination and plant establishment and survival. It also asked for justification of disruption of the test plots in the event that the proposed unit-train conveyor system was actually to encroach on the plots. This information was provided in a PMC letter dated September 23, 1983. PMC presented a plot diagram and treatment key, seed mixture planted, a synopsis of the test plot implementation procedures, and a summary of the 1983 germination and survival data. Reference to the test plots was also made in the November 30, 1983 submission of a minor modification of the Starpoint Mine's Mining and Reclamation Plan associated with the proposed unit-train loadout facility. On page 784-21 of the minor modification application under the sub-title of Topsoil Handling and Reclamation Procedures Related to Revegetation, a statement was made that the west end of the study plots would be disturbed by the conveyor system. It goes on to state that data collection would continue from the test plots until construction activities prevent further sampling, and that PMC will make appropriate arrangements concerning the test plots prior to their being disturbed.

At the present time, it appears that there will be no disturbance to the test plots until 1985. This will allow a minimum of three years of data to be collected on all of the treatments and continued sampling on the undisturbed plots. Three years of data should provide sufficient information on the effects the treatments have on the revegetation potential of the site. If necessary, long term data from the undisturbed plots will be available for subsoil at the 10 inch depth and on topsoil at 10 and 20 inch depths.

The following narrative contains PMC's response to the remaining Division's concerns about Stipulation No. 6, Research Study Plots, and the procedures for collecting and reporting the data.

RESPONSE TO STIPULATION NO. 6

In a letter dated December 9, 1983, the Division commented on the September 23, 1983 PMC response to Special Stipulation No. 6. as contained in their August 16, 1983 letter. The Division identified the following deficiencies:

DIVISION CONCERN #1

PMC should address the potential impact of coal spillage from the conveyor belt onto the test plots, which will be in close proximity to the conveyor system.

PMC RESPONSE:

The conveyor system will not spill coal onto the test plots. As shown in the November 30, 1983 Minor Modification, Map 3, Proposed Surface Facilities Map, the conveyor will cross the refuse pile in an approximately 100 foot deep cut at a distance of about 150 feet away from the nearest undisturbed test plot. The conveyor will be covered with metal housing which will substantially prevent the wind from blowing coal dust onto the plots.

DIVISION CONCERN #2

PMC should identify a probable location(s) for test plots necessary to provide equivalent information lost due to conveyor belt encroachment upon the existing lots.

PMC RESPONSE:

PMC will relocate the test plots in consultation with the Division at the time when it is known that disturbance to them is imminent. Presently, it appears that at least three years of data and possibly more will be collected before disturbance. At that time, PMC will be in a better position to delineate a new test plot area if it is determined that one is still necessary. The need to reestablish a new test plot will take into account the number of years of data that has been generated, the efficacy of the data, and the value of the remaining undisturbed plots relative to their potential to yield meaningful long term data.

DIVISION CONCERN #3

PMC should provide the rationale for deviation from the June 2, 1982 letter on test plot design and specifically address the following:

a. Why were "controls" not implemented in each depth treatment to test the effect of the "no fertilizer" treatment?

PMC RESPONSE:

Soils data from the coal waste material and the adjacent soil series indicates that there is a deficiency of nitrogen and phosphorus. In order to achieve a reasonable plant cover to stabilize the site, it is accepted that some fertilizer will have to be applied. The rate of 100 lbs/acre of 16-16-8 will be used as the control level in the test plots.

b. Why were replications not implemented in the study, or shown on Map #1?

PMC RESPONSE:

In reference to Map No. 1, there are essentially three replications to the subsoil treatment and three replications of the topsoil treatment. For each soil treatment there are two depth replications. The effect of fertilizer treatment is replicated six times. During the 1984 and 1985 data collection, each treatment will be further separated into three replications to evaluate the effect of slope position. See Figure 1 and Figure 2 in the Methods section for a treatment diagram and plot identification labels.

c. Why were the depth treatments as described in the September 23, 1983 submission implemented in an uneven fashion on the horizontal plane?

PMC RESPONSE:

Depth treatments were not implemented in an uneven fashion on the horizontal plane. Map No. 1 shows the treatment extending the entire length of the slope.

DIVISION CONCERN NO. 4

PMC should provide the sampling methodology used to generate Table #3.

PMC RESPONSE:

Table 3, 1983 Germination and Survival on Refuse Pile Vegetation Topsoil test plots, contains the estimated density of perennial plant seedlings on the refuse pile test plots. These estimates were made by counting the number of each plant species rooted within a ¼ M^2 quadrat. A total of 90 ¼ M^2 quadrats were read for each soil treatment, i.e. 45 in each fertilizer treatment. Quadrats were randomly placed within each treatment.

In the original Table 3 that was submitted on September 23, 1983, there were metric to English conversion errors. A copy of the revised Table 3 is given below. Also, please reference the Plateau Mining Company Annual Reclamation Report, January 1984, Table 18, 1983 Seedling Density Refuse Pile Study, for plant densities by species. A copy of the reclamation report that pertains to the Refuse Pile Research Plots is attached for your convenience of reference.

TABLE 3A *
1983 GERMINATION AND SURVIVAL
REFUSE PILE VEGETATION - TOPSOIL TEST PLOTS (#/FT ^{2})

		FERTILIZER	
PLOT	TREATMENT	100#/a	200#/a
A	Coal Waste	0.71	- - -
B	20" Subsoil	3.57	4.25
D	10" Subsoil	2.79	3.20
D	10" Subsoil	2.79	3.20
C	10" TOP/10" Subsoil	1.99	2.49
E	20" TOPSOIL	1.11	1.66
F	10" TOPSOIL	0.90	1.16
G**	1" TOPSOIL	2.51	- - -

** All plots are north aspect except G which is south aspect

* Revised December 1983

METHODS

The Refuse Pile Research Study Plots are comprised of two main treatments, soil material and depth of soil material. Soil materials are composed of topsoil, subsoil, layered topsoil/subsoil, and coal waste material. Each source of soil material has been applied at depths of ten inches and twenty inches with the exception of the layered topsoil/subsoil which was applied at a depth of twenty inches only and the coal waste material which is the refuse material over which the other soil materials has been placed. Each main soil treatment plot is divided into two fertilizer sub-treatments and three slope effect plots. Fertilizer, 16-16-8, was applied at the rates of 100 lbs/acre and 200 lbs/acre. Fertilizer treatment plots have been partitioned into upper, middle and lower slope with three sub-plots within each slope factor plot. A diagram of this is presented in Figure 1, Example of the Division of Treatments Into Sub-Sampling Plots.

Sub-plots will serve as the basic unit for the location of randomized transects for data collection.

Within each sub-plot, a transect will be placed perpendicular to the slope at a randomly selected distance from the lower right corner of the plot. One transect will be read per sub-plot for a total of three transects per replication. A total of nine transects will be read per fertilizer sub-treatment for a total of 18 transects per soil material treatment at each depth. Each transect will consist of 100 point-hits for plant cover and three $\frac{1}{4}m^2$ quadrats for plant production. This results in 1800 cover hits and 54 quadrats per main soil material treatment.

Data collection will begin in mid-July. Plant parameters which will be measured are percent cover by species and total production by life form. Production data will further be separated by annuals and perennials. Cover estimates will be derived from a 10-point frame placed at 10 equally spaced intervals along the transect. Plant production will be estimated from clipping three $\frac{1}{4}m^2$ quadrats randomly placed along the transect. Plants will be clipped at ground level. Transect averages will comprise one datum for statistical analysis.

Statistical analysis will be performed to determine if significant differences exist in cover and production between treatments. The statistical test to be applied will be a multi-way ANOVA based on the plot design which is a nested split-split, incomplete, randomized block design. This design is best illustrated in Figure 2 Refuse Pile Research Study Data Organization For Computer Impact And Field Form Identification. Soil material is the first factor in the analysis and consists of four levels: (1) topsoil, (2) subsoil, (3) layered topsoil/subsoil, (4) coal waste. Factor two is soil depth at two levels of 10 inches and 20 inches. Factor three is fertilizer rate at two levels, 100 lbs/acre and 200 lbs/acre. Factor four takes into account the differences due to effect of the position on the slope. The first three factors are implemented in rectangular plots which extend the entire length of the slope from the ridge to the toe of the slope. Factor number four divides the slope into the upper, middle, and lower one-third of the slope. Data will be collected and organized according to the outline presented in Figure 2, Refuse Pile Research Study Data Organization For Computer Input And Field Form Identification. In addition to the analysis of variance, the data will be subjected to the Duncan's Multiple-Range Test which will rank and give significant differences between treatment means. All of the analysis will be performed at the 0.05 confidence level and run on Getty Oil Company's IBM computer network, SAS Institute, Statistical Analysis System.

Field data will be summarized, analyzed, and a formal report will be prepared for submission to the Division by September 30. Ultimately the results will be evaluated in terms of the technical feasibility of the treatment and the economic consideration of those treatments which achieve an acceptable revegetation success standard.

Acceptable revegetation will be determined by comparison of plant cover on the research plots to that of the Topsoil Reference Areas which were established in 1982 for the purpose of evaluating revegetation success. Cover on the research plots will need to be equal to or greater than the cover on the reference areas.

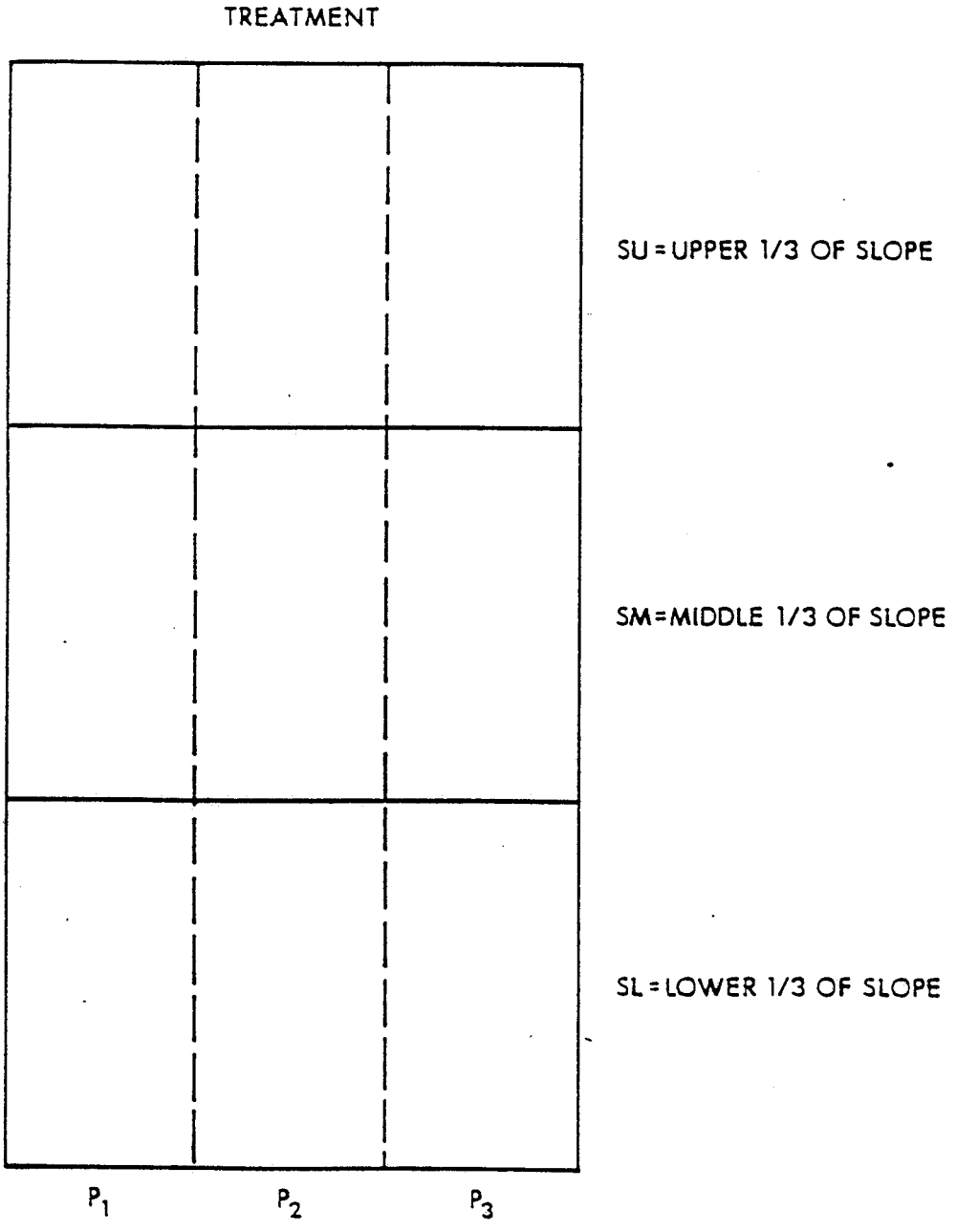


FIGURE 1 - EXAMPLE OF THE DIVISION OF TREATMENTS INTO SUB-SAMPLING PLOTS.

NOTE : P_n = SUB-SAMPLING PLOT.

TREATMENT = SOIL MATERIAL + SOIL DEPTH + FERTILIZER.

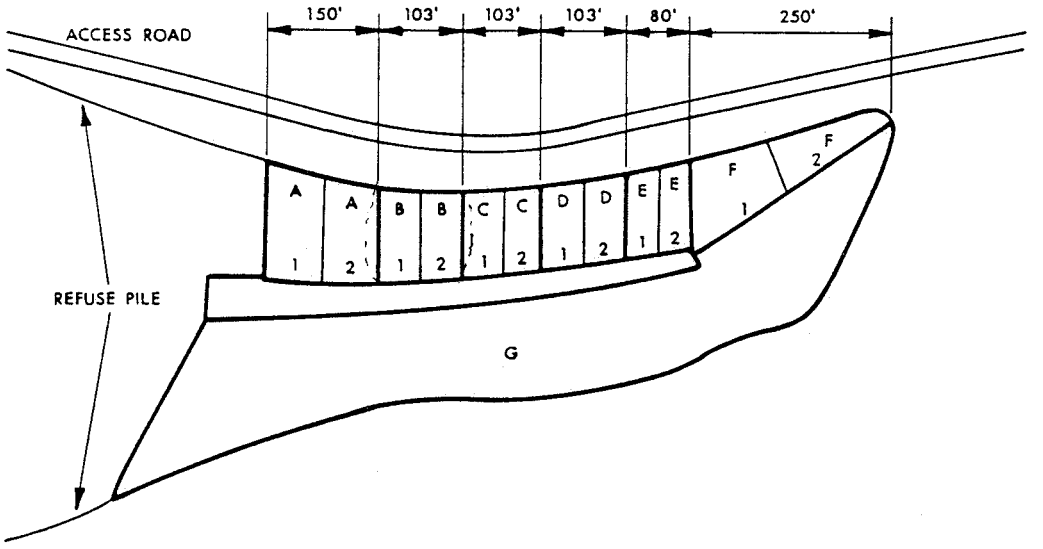
REFUSE PILE RESEARCH STUDY
DATA ORGANIZATION FOR COMPUTER INPUT AND FIELD FORM INFORMATION

Dn = DEPTH OF SOIL MATERIAL	D1 = 10" DEPTH	SLOPE FACTOR		Mn = SOIL MATERIAL							
				M1 = TOPSOIL		M2 = SUBSOIL		M3 = 10" TOP/10" SUB		M4 = COAL WASTE	
				Fn = FERTILIZER RATE		Fn = FERTILIZER RATE		Fn = FERTILIZER RATE		Fn = FERTILIZER RATE	
				F1 = 100 #/a	F2 = 200 #/a	F1 = 100 #/a	F2 = 200 #/a	F1 = 100 #/a	F2 = 200 #/a	F1 = 100 #/1	F2 = 200 #/1
	D1 = 10" DEPTH	SLOPE FACTOR	SU	SU M1-F1-D1	SU M1-F2-D1	SU M2-F1-D1	SU M2-F2-D1	—	—	SU M4-F1-D1	SU M4-F2-D1
			SM	SM M1-F1-D1	SM M1-F2-D1	SM M2-F1-D1	SM M2-F2-D1	—	—	SM M4-F1-D1	SM M4-F2-D1
			SL	SL M1-F1-D1	SL M1-F2-D1	SL M2-F1-D1	SL M2-F2-D1	—	—	SL M4-F1-D1	SL M4-F2-D1
	D2 = 20" DEPTH	SLOPE FACTOR	SU	SU M1-F1-D2	SU M1-F2-D2	SU M2-F1-D2	SU M2-F2-D2	SU M3-F1-D2	SU M3-F2-D2	—	—
			SM	SM M1-F1-D2	SM M1-F2-D2	SM M2-F1-D2	SM M2-F2-D2	SM M3-F1-D2	SM M3-F2-D2	—	—
			SL	SL M1-F1-D2	SL M1-F2-D2	SL M2-F1-D2	SL M2-F2-D2	SL M3-F1-D2	SL M3-F2-D2	—	—

FIGURE 2

FIGURE 2

REFUSE PILE VEGETATION - TOPSOIL TEST PLOT LAYOUT



PLOT	TREATMENT KEY (INCHES) SOIL MATERIAL & DEPTH	(16-16-8) FERTILIZER LBS/ACRE	SEED MIX SPECIES	POUNDS PLS/ACRE
A1	Coal Waste	100	Slender Wheatgrass	3.0
A2	Coal Waste	200	Western Wheatgrass	3.0
B1	20" Subsoil	200	Tall Fescue	2.0
B2	20" Subsoil	100	G.B. Wildrye	3.0
C1	10" Topsoil/10" Subsoil	100	Blue Bunch Wheatgrass	3.0
C2	10" Topsoil/10" Subsoil	200	Scarlet Globemallow	0.5
D1	10" Subsoil	200	Penstemon	0.5
D2	10" Subsoil	100	Cicer Milkvetch	1.0
E1	20" Topsoil	100	Yellow Sweetclover	1.0
E2	20" Topsoil	200	Rubber Rabbitbrush	0.5
F1	10" Topsoil	200	Big Sagebrush	0.1
F2	10" Topsoil	100	Green Ephedra	2.0
G	10" Subsoil	100	4-wing Saltbrush	1.0
			TOTAL	20.6