

Table 10, 1985 Conveyor Reclamation Plant Cover.

| Plant Species            | % Cover     | % Composition | Frequency |
|--------------------------|-------------|---------------|-----------|
| <u>Perennial Grasses</u> |             |               |           |
| Intermediate wheatgrass  | 2.63        | 25.02         | 94        |
| Desert wheatgrass        | 1.87        | 17.81         | 53        |
| Smooth bromegrass        | 0.77        | 7.33          | 53        |
| Indian ricegrass         | 0.16        | 1.49          | 10        |
| Western wheatgrass       | 0.04        | 0.36          | 3         |
| Sand dropseed            | 0.04        | 0.42          | 3         |
|                          | <u>5.51</u> |               |           |
| <u>Annual Grasses</u>    |             |               |           |
| <u>Perennial Forbs</u>   |             |               |           |
| Yellow sweetclover       | 0.48        | 4.59          | 44        |
| Sulfur eriogonum         | 0.29        | 2.80          | 19        |
| Cicer milkvetch          | 0.16        | 1.49          | 13        |
| Cryptantha               | 0.01        | 0.12          | 3         |
|                          | <u>0.94</u> |               |           |
| <u>Annual Forbs</u>      |             |               |           |
| Russian thistle          | 1.81        | 17.28         | 75        |
| Halogeton                | 1.16        | 11.02         | 38        |
| Summer cypress           | 0.03        | 0.30          | 3         |
|                          | <u>3.0</u>  |               |           |
| <u>Shrubs</u>            |             |               |           |
| Shadscale                | 0.41        | 3.93          | 16        |
| Cuneate saltbush         | 0.31        | 2.92          | 13        |
| Rubber rabbitbrush       | 0.18        | 1.67          | 16        |
| Fourwing saltbush        | 0.15        | 1.43          | 9         |
|                          | <u>1.05</u> |               |           |
| TOTAL PLANT COVER        | 10.49       | 99.98         |           |
| LITTER                   | 11.48       |               |           |
| ROCK                     | 20.42       |               |           |
| BARE                     | 57.62       |               |           |

Table 11, 1985 Mine # 1 Reclamation Plant Cover.

| Plant Species            | % Cover | % Composition | Frequency |
|--------------------------|---------|---------------|-----------|
| <u>Perennial Grasses</u> |         |               |           |
| Intermediate wheatgrass  | 5.59    | 39.13         | 100       |
| Orchardgrass             | 3.82    | 26.71         | 88        |
| Sheep fescue             | 0.58    | 4.06          | 35        |
| Great Basin wildrye      | 0.37    | 2.55          | 13        |
| Foxtail barley           | 0.27    | 1.85          | 18        |
| Smooth bromegrass        | 0.24    | 1.64          | 8         |
| Desert wheatgrass        | 0.20    | 1.36          | 18        |
| Slender wheatgrass       | 0.13    | 0.87          | 5         |
| Salina wildrye           | 0.10    | 0.66          | 10        |
| Kentucky bluegrass       | 0.06    | 0.42          | 8         |
| Indian ricegrass         | 0.06    | 0.42          | 3         |
| Sandberg bluegrass       | 0.05    | 0.32          | 13        |
| Western wheatgrass       | 0.02    | 0.13          | 3         |
| Bottlebrush squirreltail | 0.02    | 0.10          | 3         |
| <u>Annual Grasses</u>    |         |               |           |
| Cheatgrass brome         | 0.08    | 0.52          | 3         |
| <u>Perennial Forbs</u>   |         |               |           |
| Curlycup gumweed         | 1.42    | 9.90          | 60        |
| Alfalfa                  | 0.41    | 2.83          | 28        |
| Sulfur eriogonum         | 0.20    | 1.36          | 8         |
| Eaton fleabane           | 0.16    | 1.08          | 5         |
| Yellow sweetclover       | 0.14    | 0.98          | 20        |
| Spreading Aster          | 0.08    | 0.52          | 5         |
| Canada thistle           | 0.02    | 0.14          | 5         |
| Looseflower milkvetch    | 0.01    | 0.07          | 3         |
| Western yarrow           | 0.01    | 0.07          | 3         |
| Cicer milkvetch          | 0.01    | 0.07          | 3         |
| <u>Annual Forbs</u>      |         |               |           |
| Chorispora               | 0.03    | 0.21          | 3         |
| Russian thistle          | 0.01    | 0.07          | 3         |
| Summer cypress           | 0.01    | 0.07          | 3         |
| <u>Shrubs</u>            |         |               |           |
| Big sagebrush            | 0.21    | 1.43          | 13        |
| Rubber rabbitbrush       | 0.04    | 0.24          | 3         |
| Broom snakeweed          | 0.01    | 0.07          | 3         |
| Douglas rabbitbrush      | 0.01    | 0.07          | 3         |
| TOTAL PLANT COVER        | 14.29   | 99.92         |           |
| LITTER                   | 22.36   |               |           |
| ROCK                     | 16.05   |               |           |
| BARE                     | 47.31   |               |           |

Table 12, Number of Refuse Plot Samples Needed for Sample Adequacy.

| <u>PLOT</u> | <u>PARAMETER</u> | <u># OF SAMPLES COLLECTED</u> | <u>SAMPLES REQUIRED N80/10</u> |
|-------------|------------------|-------------------------------|--------------------------------|
| B1          | Cover            | 15                            | 9.7                            |
|             | Density          | 23                            | 22.8                           |
|             | Production       | 15                            | 17.6                           |
| B2*         | Cover            | 10                            | 7.8                            |
|             | Density          | 9                             | 4.9                            |
|             | Production       | 10                            | 16.5                           |
| C1*         | Cover            | 10                            | 6.9                            |
|             | Density          | 26                            | 17.3                           |
|             | Production       | 4                             | 26.4                           |
| C2          | Cover            | 10                            | 4.4                            |
|             | Density          | 26                            | 23.9                           |
|             | Production       | 20                            | 44.7                           |
| D1          | Cover            | 7                             | 6.8                            |
|             | Density          | 10                            | 9.7                            |
|             | Production       | 27                            | 22.0                           |
| D2          | Cover            | 14                            | 11.7                           |
|             | Density          | 20                            | 18.3                           |
|             | Production       | 27                            | 41.9                           |
| E1          | Cover            | 8                             | 7.6                            |
|             | Density          | 6                             | 2.3                            |
|             | Production       | 27                            | 33.4                           |
| E2**        | Cover            | 14                            | 13.0                           |
|             | Density          | 28                            | 26.9                           |
|             | Production       | 9                             | 28.0                           |
| F1          | Cover            | 5                             | 2.8                            |
|             | Density          | 14                            | 13.2                           |
|             | Production       | 27                            | 96.4                           |
| F2          | Cover            | 8                             | 7.7                            |
|             | Density          | 11                            | 8.2                            |
|             | Production       | 27                            | 15.7                           |
| G           | Cover            | 15                            | 13.3                           |
|             | Density          | 27                            | 50.5                           |
|             | Production       | 27                            | 93.2                           |

\* Denotes plots disturbed by construction of the Unit Train Loadout Conveyor in 1985. Due to the reduced area of these plots insufficient area existed on some plots to take a sufficient number of samples to achieve sample adequacy.

\*\*One bag of production samples was lost enroute to the office.

Table 13, Refuse Test Plots Comparison of Plant Growth Mediums.

| <u>Total Cover %</u>                              | <u>Mean</u> |
|---|-------------|
| Topsoil   | 23.20c*     |
| Subsoil   | 12.63a      |
| Topsoil Over Subsoil                              | 17.55b      |
| <br>  |             |
| <u>Shrub Density (# stems/150 ft<sup>2</sup>)</u> |             |
| Topsoil   | 6.78a       |
| Subsoil   | 6.42a       |
| Topsoil Over Subsoil                              | 5.93a       |
| <br>  |             |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |
| Topsoil   | 9.88a       |
| Subsoil   | 8.60a       |
| Topsoil Over Subsoil                              | 10.40a      |

\*Means within a given parameter followed by a different letter are significantly different at the 0.05 level using the Duncan's Multiple Range Test.

Table 14, Refuse Test Plots Soil Depth Interactions.

| <u>TREATMENT</u>                                   | <u>Mean Value</u> |
|--|-------------------|
| <u>Total Cover (%)</u>                             |                   |
| 10" Topsoil  | 24.31d*           |
| 10" Subsoil  | 9.86a             |
| 20" Topsoil  | 22.55d            |
| 20" Subsoil  | 14.96b            |
| 10" Topsoil Over 10" Subsoil                       | 17.55c            |
| <u>Shrub Density (# plants/150 ft<sup>2</sup>)</u> |                   |
| 10" Topsoil  | 7.90b             |
| 10" Subsoil  | 13.28c            |
| 20" Topsoil  | 9.88c             |
| 20" Subsoil  | 4.21a             |
| 10" Topsoil Over 10" Subsoil                       | 11.58d            |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>    |                   |
| 10" Topsoil  | 6.63b             |
| 10" Subsoil  | 5.55a             |
| 20" Topsoil  | 6.72b             |
| 20" Subsoil  | 6.43ab            |
| 10" Topsoil Over 10" Subsoil                       | 5.95ab            |

Annual cover  
2.18

\*Means within a given parameter followed by a different letter are significantly different at the 0.05 level using the Duncan's Multiple Range Test.

Table 15, Refuse Test Plots Fertilizer Effect On Plant Growth.

| <u>FERTILIZER RATE</u>                            | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |                  |          |                |
| 100 #/Acre  | 16.14       | 3.58             | 50       | 3.316*         |
| 200 #/Acre  | 18.64       | 4.04             | 53       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |                  |          |                |
| 100 #/Acre  | 11.22       | 3.16             | 37       | 3.616**        |
| 200 #/Acre  | 9.05        | 3.03             | 89       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |                  |          |                |
| 100 #/Acre  | 6.29        | 2.47             | 95       | 1.163          |
| 200 #/Acre  | 6.76        | 3.24             | 116      |                |

\* Means are significantly different at alpha = 0.01 using the two tailed t-test.

\*\* Means are significantly different at alpha = 0.001 using the two tailed t-test.

Table 16, Refuse Test Plots Fertilizer Effect On Subsoil.

| <u>FERTILIZER RATE</u>                            | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |                  |          |                |
| 100 #/Acre  | 11.38       | 2.74             | 24       | 2.948*         |
| 200 #/Acre  | 13.99       | 3.26             | 22       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |                  |          |                |
| 100 #/Acre  | 14.13       | 4.17             | 20       | 7.600**        |
| 200 #/Acre  | 6.76        | 1.91             | 29       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |                  |          |                |
| 100 #/Acre  | 6.79        | 2.40             | 37       | 3.567**        |
| 200 #/Acre  | 4.98        | 2.11             | 42       |                |

\* Means are significantly different at alpha = 0.01 using the two tailed t-test.

\*\* Means are significantly different at alpha = 0.001 using the two tailed t-test.

Table 17, Refuse Test Plots Fertilizer Effect On Topsoil.

| <u>FERTILIZER RATE</u>                            | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |                  |          |                |
| 100 #/Acre  | 23.00       | 4.95             | 16       | 0.326          |
| 200 #/Acre  | 23.56       | 5.33             | 21       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |                  |          |                |
| 100 #/Acre  | 7.79        | 1.33             | 17       | 2.012*         |
| 200 #/Acre  | 9.55        | 3.49             | 42       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |                  |          |                |
| 100 #/Acre  | 7.18        | 2.66             | 54       | 1.416          |
| 200 #/Acre  | 6.19        | 3.98             | 36       |                |

\* Means are significantly different at alpha = 0.10 using the two tailed t-test.

Table 18, Refuse Test Plots Fertilizer Effect On Topsoil Over Subsoil.

| <u>FERTILIZER RATE</u>                            | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| 100 #/Acre  | C1          | 16.60       | 3.41             | 10       | 1.318          |
| 200 #/Acre  | C2          | 18.50       | 3.03             | 10       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| 100 #/Acre  | C1          | -           | -                | -        | 1.382          |
| 200 #/Acre  | C2          | 10.40       | 3.97             | 18       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| 100 #/Acre  | C1          | 7.79        | 3.12             | 4        | 1.382          |
| 200 #/Acre  | C2          | 5.58        | 2.91             | 20       |                |

\* Means are significantly different at alpha = 0.10 using the two tailed t-test.

Table 19, Refuse Test Plots Fertilizer Effect On Ten Inches of Subsoil.

| <u>FERTILIZER RATE</u>                            | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| 100 #/Acre  | D2          | 9.21        | 2.46             | 7        | 1.738*         |
| 200 #/Acre  | D1          | 11.14       | 2.27             | 14       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| 100 #/Acre  | D2          | 14.13       | 4.71             | 20       | 1.551          |
| 200 #/Acre  | D1          | 11.60       | 2.86             | 10       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| 100 #/Acre  | D2          | 4.22        | 2.13             | 27       | 4.198**        |
| 200 #/Acre  | D1          | 6.88        | 2.52             | 27       |                |

\* Means are significantly different at alpha = 0.10 using the two tailed t-test.

\*\* Means are significantly different at alpha = 0.001 using the two tailed t-test.

Table 20, Refuse Test Plots Fertilizer Effect On Twenty Inches of Subsoil.

| <u>FERTILIZER RATE</u>                            | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| 100 #/Acre  | B2          | 14.40       | 3.13             | 10       | 0.653          |
| 200 #/Acre  | B1          | 15.33       | 3.72             | 15       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| 100 #/Acre  | B2          | 5.00        | 0.87             | 9        | 2.086*         |
| 200 #/Acre  | B1          | 3.91        | 1.46             | 23       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| 100 #/Acre  | B2          | 6.52        | 2.07             | 10       | 0.183          |
| 200 #/Acre  | B1          | 6.36        | 2.08             | 15       |                |

\* Means are significantly different at alpha = 0.05 using the two tailed t-test.

Table 21, Refuse Test Plots Fertilizer Effect On Ten Inches of Topsoil.

| <u>FERTILIZER RATE</u>                            | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| 100 #/Acre  | F2          | 23.63       | 5.10             | 8        | 0.688          |
| 200 #/Acre  | F1          | 25.40       | 3.29             | 7        |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| 100 #/Acre  | F2          | 6.09        | 1.36             | 11       | 3.680*         |
| 200 #/Acre  | F1          | 9.32        | 2.64             | 14       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| 100 #/Acre  | F2          | 8.14        | 2.52             | 27       | 3.365*         |
| 200 #/Acre  | F1          | 5.12        | 3.92             | 27       |                |

\* Means are significantly different at alpha = 0.01 using the two tailed t-test.

Table 22, Refuse Test Plots Fertilizer Effect On Twenty Inches of Topsoil.

| <u>FERTILIZER RATE</u>                            | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| 100 #/Acre  | E1          | 22.38       | 4.81             | 8        | 0.103          |
| 200 #/Acre  | E2          | 22.64       | 6.36             | 14       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| 100 #/Acre  | E1          | 10.92       | 1.28             | 6        | 0.769          |
| 200 #/Acre  | E2          | 9.66        | 3.91             | 28       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| 100 #/Acre  | E1          | 6.21        | 2.80             | 27       | 2.595*         |
| 200 #/Acre  | E2          | 9.38        | 4.15             | 9        |                |

\* Means are significantly different at alpha = 0.01 using the two tailed t-test.

Table 23, Refuse Test Plots Conveyor Edge Effect.

| <u>FERTILIZER RATE</u>                            | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |                  |          |                |
| Near  | 15.00       | 2.98             | 8        | 1.302          |
| Away  | 17.50       | 4.54             | 8        |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |                  |          |                |
| Near  | 5.00        | 2.56             | 8        | 1.622          |
| Away  | 6.38        | 3.78             | 8        |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |                  |          |                |
| Near  | 4.99        | 2.55             | 8        | 0.354          |
| Away  | 7.21        | 2.91             | 8        |                |

Table 24, Refuse Test Plots Aspect Comparison.

| <u>ASPECT</u>                                     | <u>PLOT</u> | <u>MEAN</u> | <u>STD. DEV.</u> | <u>N</u> | <u>T. CAL.</u> |
|---|-------------|-------------|------------------|----------|----------------|
| <u>Total Cover (%)</u>                            |             |             |                  |          |                |
| North   | D2          | 9.21        | 2.46             | 14       | 6.509*         |
| South   | G           | 19.93       | 5.68             | 15       |                |
| <u>Shrub Density (# plants/150ft<sup>2</sup>)</u> |             |             |                  |          |                |
| North   | D2          | 14.13       | 4.71             | 20       | 9.323*         |
| South   | G           | 4.33        | 2.40             | 27       |                |
| <u>Production (grams per 1/4 m<sup>2</sup>)</u>   |             |             |                  |          |                |
| North   | D2          | 4.22        | 2.13             | 27       | 2.281**        |
| South   | G           | 6.59        | 4.96             | 27       |                |

\* Means are significantly different at alpha = 0.001 using the two tailed t-test.

\*\* Means are significantly different at alpha = 0.05 using the two tailed t-test.

Table 25, Comparison of Refuse Test Plots by Vegetative Characteristic.

| PLOT       | % TOTAL COVER <sup>9/</sup> |        | PRODUCTION (grams/1/4M2) <sup>9/</sup> |      | SHRUB DENSITY (stems/150 ft <sup>2</sup> ) |
|------------|-----------------------------|--------|--|------|--|
|            |                             |        |  |      |  |
| B1 20" sub | 15.33b*                     | 10.5 I | 6.36ab                                 | 7.2  | 3.91a                                      |
| B2 20" sub | 14.40ab                     | 13.0 J | 6.52ab                                 | 6.3  | 5.00b                                      |
| C1 10"/10" | 16.60bc                     | 13.8 A | 7.79b                                  | 8.1  | -  |
| C2 10"/10" | 18.50c                      | 17.0 A | 5.56a                                  | 12.6 | 10.40d                                     |
| D1 10" sub | 11.14a                      | 12.0 A | 6.88b                                  | 8.7  | 11.60e                                     |
| D2 10" sub | 9.21a                       | 12.0 A | 4.22a                                  | 8.7  | 14.13e                                     |
| E1 20" top | 22.38d                      | 13.4 A | 6.21ab                                 | 9.6  | 10.92d                                     |
| E2 20" top | 22.64b                      | 13.4 A | 9.38b                                  | 11.7 | 9.66d                                      |
| F1 10" top | 25.40d                      | 21.4 J | 5.12a                                  | 10.5 | 9.32d                                      |
| F2 10" top | 23.63d                      | 26.7 A | 8.14b                                  | 16.8 | 6.09c                                      |
| G 10" sub  | 19.33cd                     | 18.4 A | 6.59ab                                 |      | 4.33ab                                     |

\*Means with a column followed by a different letter are significantly different at the 0.05 level using the Duncan's Multiple Rule Test.

20" - 18.3% cover, 6.97 gr/.25m<sup>2</sup> production  
 10" - 17.3% cover, 6.09 gr/.25m<sup>2</sup>

Table 26, Revegetation Successfulness of Refuse Test Plots.

| <u>SITE</u>                               | <u>TOTAL COVER</u> | <u>PRODUCTION</u> | <u>SHRUB DENSITY</u> |
|---|--------------------|-------------------|----------------------|
| Reference Area                            | 23.5%              | 6.21              | 900/2,200            |
| A = no Soil, 0#/acre                      |                    |                   |                      |
| <b>PLOTS</b>                              |                    |                   |                      |
| B1 20" subsoil, 100#/acre                 | no                 | yes               | no                   |
| B2 20" subsoil, 200#/acre                 | no                 | yes               | yes                  |
| C1 10" subsoil, 100#/acre<br>10" topsoil  | no                 | yes               | yes                  |
| C2 10", 10", 200#/acre                    | no                 | yes               | yes                  |
| D1 10" subsoil, 100#/acre                 | no                 | yes               | yes                  |
| D2 10" subsoil, 200#/acre                 | no                 | no                | yes                  |
| E1 20" topsoil + 100#/acre                | yes                | yes               | yes                  |
| E2 20" topsoil + 200#/acre                | yes                | yes               | yes                  |
| F1 10" topsoil + 100#/acre                | yes                | yes               | yes                  |
| F2 10" topsoil + 200#/acre                | yes                | yes               | no                   |
| G South aspect<br>10" topsoil + 100#/acre | yes                | yes               | yes                  |

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**STAR POINT MINES**

**1991 ANNUAL RECLAMATION**

**MONITORING REPORT**

PREPARED FOR

CYPRUS PLATEAU MINING CORPORATION  
P.O. DRAWER PMC  
PRICE, UTAH 84501

PREPARED BY

IME  
P.O. BOX 270  
YAMPA, CO 80483

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## INTRODUCTION

This annual reclamation monitoring report is submitted by Cyprus-Plateau Mining Corporation, hereafter referred to as Plateau, in accordance with their approved Mining and Reclamation Plan contained in the Star Point Mines Permit No. ACT/007/006, which requires that all previously reclaimed sites be monitored during years 1, 2, 3, 5, 9 and 10 following reclamation to determine the relative degree of revegetation success of these areas. The Permit also requires that the results and interpretation of these data be submitted to the Utah Division of Oil, Gas and Mining (Division), each year in the form of an annual reclamation monitoring report. This report contains the results of revegetation data collected between July 16 and August 21, 1991, for all areas which required monitoring in 1991. These data were collected by Kent Crofts, Mark Jones and Michael Jones. The reclamation monitoring program conducted in 1990 is consistent with previously collected data and with Plateau's presently approved Permit.

Plateau has monitored the status of revegetation on reclaimed lands continuously since 1981, the results of which have been previously submitted on an annual basis to the Division. Due to the voluminous nature of these data it is impractical to provide a complete summary of the revegetation trends for each reclaimed site evaluated in the present report. Therefore, in order to completely understand the history and results of the prior reclamation monitoring, the reviewer is referred to these previous submittals.

## METHODS

The data collected during the 1991 monitoring effort utilized identical sampling methodologies, equipment, observers and methods of data collection and analysis used previously and which have been approved by the Division in earlier submittals. The parameters sampled included total plant cover, woody plant densities and forage production. Given the similarity of previous sampling methodologies and observers, Plateau believes that a comparison of the 1991 data with formerly collected data is possible to establish trends regarding the successfulness of past revegetation efforts.

Plant Cover. Plant cover was monitored using two different sampling techniques. On the flatter, more accessible areas associated with the Refuse Test Plots and Sagebrush Reference Area, plant cover was evaluated using an inclined metal ten point frame. On the Refuse Test Plots, a fifty foot transect length was used, while on the Sagebrush Reference Area a fifty meter transect length was used. Along each transect, the ten point frame was randomly located at intervals using random numbers, generated from a hand held calculator, which were assigned to the data sheets prior to going to the field. Along each transect, ten sample sites equalling one hundred datum points were evaluated. All foliar plant cover less than one meter in height was sampled. At each sample point, the observation was recorded by individual plant species, or whether or not litter, rock, bare ground, lichens or cryptogams were encountered. Plant material that had dried prior sampling (such as annuals), but which were a product of the 1991 growing season, was counted as plant cover. Litter was defined as that plant material which had been dead for approximately one year prior to sampling. The one hundred datum points were summarized into a single observation for subsequent statistical analyses. To the extent possible, all transects were randomly located with respect to orientation and intervals between transects by assigning random numbers to the major compass headings while the interval between each transect was determined using a similar random number.

On steeper slopes, encountered along the Lion Deck Portal Access Road and

along the Conveyor, reclaimed in 1981, it was deemed unsafe because of the steep slopes to use the ten point frame. On these areas, plant cover was estimated using a 2 X 5 dm quadrat. Transect length was 14.52 feet. These transects were randomly located throughout the area to be sampled using the randomization methodology described above. At each transect five plots were sampled. These five datums were then averaged into a transect value for statistical analyses.

Woody Plant Densities. On the Refuse Test Plots, woody plant densities were determined using a 3 X 50 foot belt transect, while on the Sagebrush Reference Area a 3 X 50 meter belt transect was used. The tape used for the cover transect was also used as the center point for the woody plant density transects. Each side of the transect tape was sampled for woody plants and these two values were averaged into a single observation for purposes of data summarization.

Woody plant densities were sampled only on the permanently reclaimed sites and thus no woody plant density sampling occurred on the interim reclaimed areas associated with the 1981 Reclamation Seedings.

Production. Total forage production was determined by clipping at ground level all biomass produced during the 1991 growing season within a one quarter square meter circular quadrat. On each production transect, five randomly spaced quadrats were clipped and these five plots were averaged into a single datum. Clipped plant materials were placed into labeled paper sacks and weighted in the field to determine green weights for initial sample adequacy determinations. Following completion of the field sampling, the production samples were returned to the laboratory where each sample bag was dried until free of moisture then weighted on an electric scale to an accuracy of one tenth of a gram.

Data Analysis. All of the field data were initially summarized in the field to determine plot values. Sample adequacy equations recommended by the Division were calculated on all

data. Total plant cover and shrub density sample adequacy calculations were made in the field prior to leaving each sample plot. Final sample adequacy calculations were prepared in the laboratory following final completion of the data summary sheets. Sample adequacy calculations on production samples were initially based on green weights and were determined either in the field or at the completion of each sampling day. In accordance with the previously approved sampling program for the Refuse Test Plots, a sufficient number of samples were taken to satisfy the 80/10 confidence interval requirement or until a maximum of 27 samples per plot had been collected. Statistical analyses of these data were performed using the NCSS statistical software package on an AT personal computer. Statistical tests performed included the two tailed t-test and ANOVA. Unless otherwise noted, the confidence interval for all statistical comparisons was the 0.10 percent level. Data collected from the Conveyor Edge Effect Sampling and from the one south facing plot were not included in the statistical analyses in order to ensure that uniformity of data was used with respect to slope and aspect.

Revegetation Success Criteria. Since only one of the approved Reference Areas was sampled to the required sample adequacy level, absolute comparisons regarding revegetation success on each individual reclaimed area with its appropriated Reference Area could not be made. Therefore, comparisons of the apparent degree of revegetation success on each reclaimed site were compared with data collected from these sites during either 1981 or 1983. A summary of the 1981-83 Reference Area Plant Cover values is presented below:

| <u>Reference Area</u> | <u>% Total Plant Cover</u> |
|-----------------------|----------------------------|
| Mountain Shrub        | 45.3                       |
| Sagebrush             | 42.1                       |
| Douglas Fir           | 15.1                       |
| Mountain Grassland    | 43.6                       |
| Pinyon Juniper - West | 12.8                       |
| Pinyon Juniper - East | 32.5                       |
| Saltbush              | 17.5                       |
| Corner Canyon Aspen   | 87.6                       |

## RESULTS AND DISCUSSION

### SAGEBRUSH REFERENCE AREA

To determine the successfulness of the reclamation efforts associated with the Refuse Test Plots, the Division has determined that these sites should be considered as permanent reclamation; therefore, it was necessary to sample the Reference Area corresponding to this site. Thus, the vegetative characteristics of the Refuse Test Plots were compared with the Sagebrush Reference Area which is the vegetation type corresponding to the majority of this area prior to its disturbance. This comparison utilizes the Reference Area Comparison Method described in the Division's Vegetation Guidelines.

To characterize the vegetative properties of the Sagebrush Reference Area, a total of five cover, thirteen production and five density transects were taken. Summaries of these data are presented on Table 1, Sagebrush Reference Area Cover, Table 2, Sagebrush Reference Area Production and Table 3, Sagebrush Reference Area Woody Plant Density. Data were previously collected on the Sagebrush Reference Area in 1981, 1990 and 1991. Since different sampling methodologies were used in 1981 the following discussion will not include the 1981 data in these comparisons and will address only data collected in 1990 and 1991, using similar sampling methodologies.

During the 1991 sampling, it was determined that the plant cover on this site averaged 22.00 percent (Table 1, Sagebrush Reference Area Cover). This compares with 23.5 percent plant cover found on this site in the 1990 sampling effort. The same observer collected the 1990 and 1991 cover data. These data suggest that plant cover has remained constant during the past two years. A *t-test* comparison of the 1990 and 1991 cover data yield a *t-statistic* of 0.640 indicating that there is no statistical difference in total plant cover for the Sagebrush Reference Area between the 1990 and 1991 sampling efforts.

Total forage production from the Sagebrush Reference Area averaged 11.04 grams

of air dry forage per one quarter square meter or 393.3 pounds of air dry forage per acre (Table 2, Sagebrush Reference Area Production). This compares with 6.21 grams per one quarter square meter or 221.3 pounds of air dry forage per acre obtained from the 1990 sampling effort. The same observer collected the 1990 and 1991 data. A *t-test* comparison of the 1990 and 1991 data resulted in a calculated *t-statistic* of 4.260 suggesting that highly significant differences existed between forage production from the 1990 and 1991 sampling efforts. These differences were significant at the 0.001 level. These differences are explained in large part by the more favorable precipitation received during the 1991 growing season and the fact that production is more responsive to differences in moisture than is cover.

Woody plant densities on the Sagebrush Reference Area were found to average 70.60 plants per 50 square meters or 5,714.4 plants per acre (Table 3, Sagebrush Reference Area Woody Plant Density). This compares with 93.44 plants per 50 square meters or 7,563.0 plants per acre obtained from the 1990 sampling of this site. Different observers calculated woody plant densities in 1990 and 1991. These differences are not unexpected due to observer differences in how multi-stemmed plants are counted. However, since the revegetation success standard for woody plant density for reclaimed sites corresponding to the Sagebrush Community are based upon a fixed standard, these differences do not affect the revegetation standards for this site.

Sample adequacy was achieved at the 90 percent level for both the cover and woody plant density sampling on this site (Table 1, Sagebrush Reference Area Cover and Table 3, Sagebrush Reference Area Woody Plant Density). A total of 13 transects, (amounting to 65 clipped plots) were obtained from this site. While sample adequacy was not achieved at the 80 percent level, the number of clipped plots exceeds the maximum sample size contained in the Division's Vegetation Guidelines.

#### 1981 RECLAMATION SEEDING

A total of 30 sample transects were evaluated to determine the degree of

revegetation on the 1981 Reclamation Seedings, located along the Lion Deck Portal Access Road and to the south of the Conveyor. Since this reclaimed area represents interim reclamation, only plant cover was sampled on these sites. The summary of the data obtained from these sample sites is presented on Table 4, 1981 Reclamation Seeding Cover.

Total plant cover on these sites averaged 20.69 percent (Table 4, 1981 Reclamation Seeding Cover). A review of the previous annual reclamation reports reveals that this site was apparently last sampled in 1986. In 1986 these sites were found to average 32.97 percent total cover, 18.81 percent cover in 1985, 22.83 percent cover in 1984 and 15.67 percent cover in 1983. Comparing the 1991 monitoring data with previously collected data from these sites suggests that percent total plant cover is slightly lower than that obtained from the 1986 sampling effort, but relatively consistent with data collected during 1983-1985 monitoring efforts. Exact reasons for this decline are unknown, but it was observed during the 1991 sampling, that all of these areas had very heavy utilization from deer and marmot browsing. It is possible that the decline in plant cover is partially attributable to these factors.

#### REFUSE TEST PLOTS

The Refuse Test Plots were established by Plateau to address Division concerns regarding the reclamation potential of the washed coal refuse material generated during the coal beneficiation process. An extensive volume of information has been exchanged between Plateau and the Division relative to these test plots. Due to its volume, this material can not be repeated here. The best summary of these test plots can be found in the 1983, 1984, 1985, 1986, 1987 and 1990 Annual Reclamation Monitoring Reports previously submitted to the Division. In summary, these test plots were initially established to address the following objectives:

1. Evaluate the effectiveness of four plant growth mediums: topsoil, subsoil, topsoil over subsoil, and straight coal refuse;
2. Compare the effects of varying depth; 10 inches of topsoil, 20 inches of topsoil,

10 inches of subsoil, 20 inches of subsoil and 10 inches of topsoil over 10 inches of subsoil; and

- 16-16-8
3. Determine the effects of supplemental fertilization applied at rates of 100 and 200 pounds per acre to the combinations described in one and two above.

Based upon the results obtained from previous monitoring efforts, minor modifications in the sampling regime have been periodically presented by Plateau and approved by the Division over the past several years. Specific agency recommendations relevant to the statistical comparisons and field sampling techniques are summarized in considerable detail in the 1986 and 1990 Annual Reclamation Monitoring Reports. The present evaluation uses identical analytical techniques and methodologies used in all previously submitted reports. The only modification being that due to the very low composition of annuals, plant cover is analyzed using only total plant cover.

In sampling the Refuse Test Plots, sufficient area is often unavailable to sample to the required 80 percent confidence interval. Therefore on these plots a sufficient number of samples were collected until sample adequacy at the 80/10 confidence interval had been achieved or until a maximum of 27 samples per plot were collected as previously approved by the Division in 1986. However, on Plots B2 and C1, disturbed during the construction of the Unit Train Loadout Conveyor, insufficient area exists to sample to these levels. The number of samples collected from each plot and the appropriate sample adequacy are presented in Table 5, Refuse Test Plot Sample Adequacy Calculations.

Plant Growth Mediums. A comparison of various plant growth mediums described in item one of the study objectives for each corresponding plot is presented in Table 6, Mean Cover, Production and Density for Refuse Test Plots. A summary of the vegetal data by plant growth medium is presented in Table 7, Comparison of Refuse Test Plots Plant Growth Mediums. These comparisons document that significantly higher plant cover is associated with the straight topsoil plots, with no differences in plant growth on the refuse and topsoil over subsoil plots. Significantly lower cover was associated with the subsoil

plots.

Forage production was determined to be highest on the straight topsoil plots and topsoil over subsoil plots. Lowest average production was associated with the subsoil plots which produced slightly less forage than did the refuse plots.

Shrub densities were found to be highest on the plots containing subsoil with the subsoil and topsoil over subsoil plots, producing significantly higher shrub densities than either the topsoil or refuse plots.

Data collected in 1990 compare reasonably well to the trends documented in 1991. For example, in 1990, significantly higher cover was also associated with the topsoil plots, with the topsoil over subsoil plots producing more plant cover than the straight subsoil plots. Identical trends existed for the 1991 data collections. Straight refuse plots were not sampled in 1990. Forage production was greater on the topsoil over subsoil plots and straight topsoil plots, just as were documented in 1990. Shrub densities in 1991 followed identical patterns as those documented in 1990. In 1990, highest shrub densities (11.58 plants per 150 ft<sup>2</sup>) were associated with the topsoil over subsoil plots while in 1991 these same plots were found to produce more shrubs (9.72 plants per 150 ft<sup>2</sup>) than either the straight topsoil (6.85 plants per 150 ft<sup>2</sup>) or refuse plots (1.83 plants per 150 ft<sup>2</sup>). The mean shrub density values for the topsoil plots were 6.78 in 1990, while in 1991 a total of 6.85 shrubs per 150 square feet were documented.

Thickness of Plant Growth Medium. All possible combinations of topsoil and subsoil depths were evaluated to determine whether or not the thickness or source of soil cover material affected plant growth. The results of this comparison suggest that plant growth is significantly affected by both the thickness and type of soil plant growth medium (Table 8, Refuse Test Plots Soil Depth Interactions).

Highest total plant cover values were associated with the 10 inch topsoil and 10

inch topsoil over subsoil plots (Table 8, Refuse Test Plots Soil Depth Interactions). Lowest total plant cover values were consistently associated with the straight subsoil plots. Straight refuse produced total plant cover values almost identical to the topsoil over subsoil plots yet significantly higher than the subsoil plots.

Forage production values were highest on the ten inch topsoil plots, followed by the twenty inch topsoil and ten inch topsoil over ten inch of subsoil plots. Lowest production was associated with the twenty inch subsoil plots.

Shrub densities were found to be lowest on the straight refuse plots followed by the twenty inch subsoil plots. Highest shrub densities were consistently associated with subsoil plots. Significantly higher shrub densities were found on the ten inch subsoil and ten inch topsoil over ten inch subsoil plots.

Comparing the 1991 data with that collected in 1990, reveals very similar trends between years. In both years highest plant cover was associated with the ten inch topsoil plots and lowest plant cover associated with the ten inch subsoil plots. Highest production in 1990 was associated with the twenty and ten inch topsoil plots while in 1991 almost identical patterns were found. Highest shrub densities in 1990 and 1991 were encountered on the ten inch subsoil plots. In both years, the ten inch topsoil over ten inch subsoil plots ranked second highest in shrub production. Lowest shrub density values for both the 1990 and 1991 monitoring efforts were associated with the 20 Inch Subsoil Plots.

Fertilization. When averaged across all treatments, fertilization was not found to influence plant response (Table 9, Fertilizer Effect On Plant Growth Across all Refuse Test Plots). These results differ from those obtained in the 1990 sampling which showed that fertilization significantly influenced both plant cover and shrub densities. Differences appear to be a result of inclusion of the refuse plots in the 1991 comparison as well as differences in moisture conditions.

On the Subsoil Plots, fertilizer was found to influence only shrub densities (Table 10, Fertilizer Effect on Plant Growth on Subsoil). Highest shrub densities were associated with the lower fertilizer rate. Previous comparisons of the influence of fertilizer on subsoil from the 1990 and 1987 monitoring, documented significant responses to all three measured plant variables. While the results obtained from the 1991 sampling are not as pronounced as those obtained from prior sampling, they document that fertilization can significantly influence plant growth on subsoil at least ten years following application.

On the Refuse Plots, fertilization was found to significantly influence production 10 years following application (Table 11, Fertilizer Effect on Plant Growth on Coal Refuse Plots). On these rather sterile soils, highest production was associated with the higher rate of fertilization ten years following application.

On the Topsoiled Plots significant differences in plant response to fertilization were documented only for production (Table 12, Fertilizer Effect on Plant Growth on Topsoil). On these plots, production was found to be inhibited at the higher fertilizer rates.

For the Topsoil Over Subsoil Plots, fertilizer was found to significantly influence both plant cover and production (Table 13, Fertilizer Effect on Plant Growth on Topsoil Over Subsoil). In both instances significantly more growth was associated with the higher fertilizer rates ten years following application.

On the Ten Inch Subsoil Plots, fertilizer did not have a measurable influence on plant growth (Table 14, Fertilizer Effect on Plant Growth on Ten Inches of Subsoil). On the twenty inch subsoil plots, significantly higher plant cover was associated with the higher fertilizer rate (Table 15, Fertilizer Effect On Plant Growth on Twenty Inches of Subsoil).

On the Ten Inch Topsoil plots, fertilizer was found to significantly influence plant cover, production and shrub densities (Table 16, Fertilizer Effect on Plant Growth on Ten Inches of Topsoil). Plant cover and production were depressed at the higher fertilizer rates

while shrub densities were increased. In 1990, significant differences in production and shrub densities were documented on these same plots. Monitoring data collected from both years document that on ten inches of topsoil the higher rates of fertilizer inhibit forage production and stimulate shrub establishment.

On Twenty Inch Topsoil Plots, fertilizer was found to influence only shrub densities (Table 17, Fertilizer Effect On Plant Growth on Twenty Inches of Topsoil). The higher levels of fertilizer were associated with significantly lower shrub density levels. A similar trend existed in 1990 but the differences were not significant.

Conveyor Edge Effect. In order to address potential agency concerns that construction activities associated with the Unit Train Loadout Conveyor construction and associated disturbance of portions of some of the Refuse Test Plots might bias the data collected from the plots adjacent to the Conveyor cut, Plateau initiated a special sampling effort in 1985 to quantify whether or not the disturbance had altered the data collected from the undisturbed plots. Identical sampling methodologies have been used in 1985, 1986, 1987, 1990 and 1991 monitoring efforts. This comparison involves sampling the "edge effect" of plots located at varying distances from the crown of the conveyor cut. The "near" transects are located five feet away from the crown of the cut while the "away" transects are located twelve feet away.

The results of this comparison are presented in Table 18, Refuse Test Plots Conveyor Edge Effect. This comparison suggests that no measurable differences in plant growth exist between the "near" or "away" plots located near the conveyor cut. Plateau believes that these comparisons confirms the conclusions reached in the 1985, 1986, 1987 and 1990 Annual Reclamation Monitoring Reports, suggesting that the undisturbed portions of the remaining plots are yielding unbiased and scientifically acceptable data.

Aspect Comparison. All but one of the Refuse Test Plots possess a northerly aspect. In all previous comparisons, only plots having a similar aspect were compared. However,

Plots D2 and G received identical treatments consisting of Ten Inches of Subsoil with 100 pounds of fertilizer, the only difference being aspect. Plot D2 has a northerly aspect with Plot G faces to the south.

The results of this comparison are presented in Table 19, Refuse Test Plots Aspect Comparison. This comparison suggests that significantly higher cover and production are associated with the south facing slope, while significantly higher shrub densities are found on the north facing slope. These trends are identical with those documented in the 1990, 1987 and 1986 monitoring efforts from these sites.

## CONCLUSIONS

Two reclaimed sites were monitored at the Star Point Mines in connection with the 1991 monitoring effort, the 1981 Reclamation Seeding and the Refuse Test Plots. The 1981 reclamation seedings represent interim reclamation while the Refuse Test Plots are considered to represent permanent reclamation. Neither site was sampled with the object of obtaining final bond release, only to document reclamation trends and determine the apparent degree of revegetation success from these two sites.

The 1981 Reclamation Seeding is located predominately on a steep south facing slope, which was predominately a Pinyon Juniper Community prior to its disturbance. Portions of this site along the Conveyor correspond to the Douglas Fir Community. Using the West facing Pinyon Juniper and Douglas Fir Reference Areas as a success standards for these sites, the average plant cover standard for this area, based upon 1981 sampling for the Douglas Fir Reference Area and 1983 sampling for the Pinyon Juniper-West Reference Area is 15.1 and 12.8 percent, respectively. The average plant cover for this site based upon the 1991 sampling is 20.69 percent. This monitoring effort suggests that for those portions of this reclaimed area corresponding to these two vegetation types, the revegetation success standard with respect to plant cover has been satisfied.

The Refuse Test Plots correspond largely to the Sagebrush Vegetation Type and if final bond release were being sought, the success standard would largely be based upon the characteristics of the Sagebrush Reference Area. Table 20, Successfulness of Revegetation Efforts on Refuse Test Plots, compares the apparent revegetation success standards from the Sagebrush Reference Area to each of the Refuse Test Plots. This comparison suggests that only three of the thirteen plots satisfy the revegetation success standard with respect to plant cover. Upon comparing production, ten of the thirteen Refuse Test Plots would satisfy the revegetation success standard with respect to production. With respect to shrub density, six of the twelve sampled plots satisfy the shrub density standard of 600 shrubs per acre on south and west facing slopes and

2,200 shrubs on north and east facing slopes.

Several differences exist between the 1990 findings regarding revegetation success and those obtained from the 1991 sampling. In 1990, five of the eleven plots sampled for cover, ten of eleven for production and eight of ten for shrub density satisfied the apparent criteria for bond release. Reasons for the apparent decrease in the level of revegetation successfulness are unknown at the present time. Future monitoring of these sites will be necessary to determine whether these differences are a result of climatic changes or some other factor.

Table 1,  
Sagebrush Reference Area Cover.

| SPECIES  | % COVER | COMPOSITION | FREQUENCY |
|--|---------|-------------|-----------|
| Grasses  |         |             |           |
| Salina Wildrye   | 1.8     | 8.18        | 100       |
| Indian Ricegrass   | 1.0     | 4.55        | 60        |
| Bottlebrush Squirreltail                                 | 0.8     | 3.64        | 60        |
| Blue Grama   | 0.6     | 2.73        | 20        |
| Forbs  |         |             |           |
| Scarlet Globemallow                                      | 0.4     | 1.82        | 40        |
| Russian Thistle  | 0.2     | 0.91        | 20        |
| Shrubs   |         |             |           |
| Big Sagebrush  | 17.0    | 77.27       | 100       |
| Rubber Rabbitbrush                                       | 0.2     | 0.91        | 20        |
| TOTAL  | 22.0    | 100.01      |           |
| BARE   | 58.8    |             |           |
| LITTER   | 18.4    |             |           |
| ROCK   | 0.6     |             |           |
| CRYPTOGRAMS  | 0.2     |             |           |
| N = 5, Mean = 22.00, SD = 3.082, Nm90 = 5.3, Nm 80 = 3.2 |         |             |           |

Table 2,  
Grassland Reference Area Production  
(grams per 1/4 m<sup>2</sup>)

| SPECIES   | PRODUCTION | COMPOSITION | FREQUENCY |
|---|------------|-------------|-----------|
| Grasses   |            |             |           |
| Salina Wildrye  | 1.63       | 14.79       | 69        |
| Indian Ricegrass  | 1.16       | 10.49       | 100       |
| Bottlebrush Squirreltail                                    | 0.86       | 7.76        | 92        |
| Blue Grama  | 0.12       | 1.07        | 15        |
| Kentucky Bluegrass  | 0.11       | 0.98        | 9         |
| Western Wheatgrass  | 0.04       | 0.33        | 8         |
| Letterman Needlegrass                                       | 0.03       | 0.29        | 8         |
| Forbs   |            |             |           |
| Scarlet Globemallow   | 0.22       | 1.99        | 62        |
| Russian Thistle   | 0.17       | 1.56        | 39        |
| Lambsquarters Goosefoot                                     | T          | 0.08        | 8         |
| Eriogonum   | T          | 0.06        | 8         |
| Shrubs  |            |             |           |
| Big Sagebrush   | 6.50       | 58.88       | 100       |
| Broom Snakeweed   | 0.19       | 1.69        | 39        |
| TOTAL   | 11.04      | 99.99       |           |
| N = 13, Mean = 11.035, SD = 4.862, Nm90 = 52.5, Nm80 = 31.9 |            |             |           |

Table 3,  
Sagebrush Reference Area Woody Plant Density.  
(# shrubs per 50 square meters)

| SPECIES             | DENSITY | COMPOSITION | FREQUENCY |
|---------------------|---------|-------------|-----------|
| Big Sagebrush       | 58.6    | 83.00       | 100       |
| Broom Snakeweed     | 9.7     | 13.74       | 80        |
| Douglas Rabbitbrush | 0.9     | 1.42        | 60        |
| Rubber Rabbitbrush  | 0.9     | 1.27        | 60        |
| Winterfat           | 0.2     | 0.28        | 40        |
| Pinyon Pine         | 0.1     | 0.14        | 20        |
| Utah Serviceberry   | 0.1     | 0.14        | 20        |
| TOTAL               | 70.6    | 99.99       |           |

N = 5, Mean = 70.600, SD = 7.627, Nm90 = 3.2, Nm80 = 1.9

Table 4,  
1981 Reclamation Seeding Cover.

| SPECIES                  | % COVER | COMPOSITION | FREQUENCY |
|--------------------------|---------|-------------|-----------|
| Grasses                  |         |             |           |
| Western Wheatgrass       | 7.05    | 34.06       | 87        |
| Smooth Bromegrass        | 1.80    | 8.70        | 50        |
| Desert Wheatgrass        | 1.47    | 7.09        | 53        |
| Russian Wildrye          | 0.45    | 2.16        | 30        |
| Orchardgrass             | 0.28    | 1.35        | 23        |
| Kentucky Bluegrass       | 0.12    | 0.58        | 10        |
| Sheep Fescue             | 0.09    | 0.45        | 7         |
| Intermediate Wheatgrass  | 0.05    | 0.26        | 7         |
| Bottlebrush Squirreltail | 0.03    | 0.13        | 3         |
| Sandberg Bluegrass       | 0.02    | 0.10        | 3         |
| Forbs                    |         |             |           |
| Cicer Milkvetch          | 3.03    | 14.66       | 20        |
| Yellow Sweetclover       | 1.36    | 6.57        | 37        |
| Russian Thistle          | 0.78    | 3.77        | 57        |
| Alfalfa                  | 0.72    | 3.48        | 30        |
| Nodding Eriogonum        | 0.70    | 3.38        | 10        |
| Eriogonum                | 0.37    | 1.77        | 3         |
| Eaton Fleabane           | 0.08    | 0.39        | 7         |
| Curleycup Gumweed        | 0.09    | 0.42        | 10        |
| Shrubs                   |         |             |           |
| Fourwing Saltbush        | 1.54    | 7.44        | 23        |
| Rubber Rabbitbrush       | 0.51    | 2.45        | 30        |
| Broom Snakeweed          | 0.09    | 0.42        | 3         |
| Antelope Bitterbrush     | 0.03    | 0.16        | 7         |
| Mountain Snowberry       | 0.02    | 0.10        | 3         |
| Douglas Rabbitbrush      | 0.01    | 0.06        | 3         |
| Big Sagebrush            | 0.01    | 0.06        | 3         |
| TOTAL                    | 20.69   | 100.01      |           |

N = 30, Mean = 20.693, SD = 9.671, Nm90 = 59.1, Nm80 = 35.9.

Table 5,  
Refuse Test Plots Sample Adequacy Calculations.

| PLOT                                     | PARAMETER  | # SAMPLES | ADEQUACY Nm80/10 |
|--|------------|-----------|------------------|
| A1<br>Refuse - 100 #                     | cover      | 32        | 30.2             |
|  | production | 32        | 92.0 (25.0)*     |
|  | density    | 32        | 97.2             |
| A2<br>Refuse - 200 #                     | cover      | 20        | 17.4             |
|  | production | 27        | 47.4 (23.9)*     |
|  | density    | 27        | 194.7            |
| B1<br>20" Subsoil - 200 #                | cover      | 8         | 4.7              |
|  | production | 8         | 11.8 (5.2)*      |
|  | density    | 27        | 27.3             |
| B2 (Disturbed)<br>20" Subsoil - 100 #    | cover      | 5         | 3.4              |
|  | production | 6         | 16.5 (2.7)*      |
|  | density    | 12        | 25               |
| C1 (Disturbed)<br>10" TS/10" SS - 100 #  | cover      | 9         | 6.5              |
|  | production | 5         | 28.7             |
|  | density    | -         | -                |
| C2<br>10" TS/10" SS - 200 #              | cover      | 6         | 4.1              |
|  | production | 6         | 2.3              |
|  | density    | 13        | 11.2             |
| D1<br>10" Subsoil - 200 #                | cover      | 12        | 7.7              |
|  | production | 8         | 22.9 (5.8)*      |
|  | density    | 26        | 24.7             |
| D2<br>10" Subsoil - 100 #                | cover      | 15        | 14.7             |
|  | production | 8         | 5.8              |
|  | density    | 25        | 23.9             |
| E1<br>20" Topsoil - 100 #                | cover      | 7         | 6.2              |
|  | production | 6         | 9.4 (4.0)*       |
|  | density    | 22        | 20.4             |
| E2<br>20" Topsoil - 200 #                | cover      | 7         | 6.4              |
|  | production | 8         | 11.1 (2.9)*      |
|  | density    | 27        | 35.3             |
| F1<br>10" Topsoil - 200 #                | cover      | 5         | 2.3              |
|  | production | 6         | 17.3 (1.7)*      |
|  | density    | 27        | 32.6             |
| F2<br>10" Topsoil - 100 #                | cover      | 6         | 5.1              |
|  | production | 9         | 6.3              |
|  | density    | 27        | 64.5             |
| G<br>10" Subsoil - 100 #<br>South Aspect | cover      | 10        | 8.3              |
|  | production | 27        | 33.6             |
|  | density    | 27        | 78.6             |

\* The first number under Production reflects adequacy calculations based on dry weights while the second value reflects adequacy based on green weights.

Table 6,  
Mean Comparison of Cover, Production and Density of Refuse Test Plots.

| PLOT | PERCENT COVER | PRODUCTION<br>(grams per 1/4 m2) | DENSITY<br>(# shrubs per 150 ft2) |
|------|---------------|----------------------------------|-----------------------------------|
| A1   | 14.66bcd*     | 7.02ab                           | 1.53a                             |
| A2   | 15.55bcd      | 9.56bcdefg                       | 2.19ab                            |
| B1   | 10.50a        | 7.21abc                          | 3.83cd                            |
| B2   | 13.00bcd      | 6.32a                            | 3.38bc                            |
| C1   | 13.78bcd      | 8.16abcd                         | -                                 |
| C2   | 17.00cd       | 12.60ghij                        | 9.77hi                            |
| D1   | 12.00abc      | 8.74abcdef                       | 9.71hi                            |
| D2   | 12.00abc      | 8.73abcde                        | 11.18i                            |
| E1   | 13.14bcd      | 9.55bcdef                        | 9.39hi                            |
| E2   | 13.43bcd      | 11.74fghij                       | 7.67gh                            |
| F1   | 21.40e        | 10.58bcdefghij                   | 6.72fg                            |
| F2   | 26.67f        | 16.90k                           | 4.09cde                           |
| G    | 18.40cde      | 14.04ghijk                       | 4.43cdef                          |

\* means within a column followed by a different letter are significantly different at the 0.05 level.

Table 7,  
Comparison of Refuse Test Plot Plant Growth Mediums.

| MEDIUM          | PERCENT COVER | PRODUCTION<br>(grams per 1/4 m2) | DENSITY<br>(# per 150 ft2) |
|-----------------|---------------|----------------------------------|----------------------------|
| Refuse          | 15.00b*       | 8.18a                            | 1.83a                      |
| Subsoil         | 11.83a        | 7.84a                            | 8.15c                      |
| Topsoil/Subsoil | 15.07b        | 10.58b                           | 9.77c                      |
| Topsoil         | 18.12c        | 10.74b                           | 6.85b                      |

\* means within a column followed by a different letter are significantly different at the 0.05 level.

| MEDIUM / DEPTH          | PERCENT COVER         | PRODUCTION<br>(grams per 1/4M2) | DENSITY<br>(# shrubs/150 ft2) |
|-------------------------|-----------------------|---------------------------------|-------------------------------|
| Refuse                  | 11.46a* 6             | 6.83a                           | 1.83a                         |
| 10" Subsoil             | 15.00c 2              | 10.58bc                         | 10.43e                        |
| 20" Subsoil             | 12.00ab 4             | 8.18ab                          | 3.69b                         |
| 10" Topsoil             | 24.27d 1              | 14.37d                          | 5.41c                         |
| 10" Topsoil/10" Subsoil | 15.39<br>13.29bc 3    | 10.58bc                         | 9.77de                        |
| 20" Topsoil             | W1001<br>15.07c 13.29 | 10.80bc                         | 8.44d                         |

\* Means within a column followed by a different letter are significantly different at the 0.05 level.

| PARAMETER                          | MEAN  | STANDARD DEVIATION | N   | t-cal | LEVEL OF SIGNIFICANCE |
|------------------------------------|-------|--------------------|-----|-------|-----------------------|
| Total Plant Cover (%)              |       |                    |     |       |                       |
| 100 # / Acre                       | 14.76 | 5.63               | 54  |       |                       |
|                                    |       |                    |     | 0.286 | NS                    |
| 200 # / Acre                       | 14.48 | 4.58               | 58  |       |                       |
| Production (grams per 1/4m2)       |       |                    |     |       |                       |
| 100 # / Acre                       | 8.82  | 5.24               | 66  |       |                       |
|                                    |       |                    |     | 1.197 | NS                    |
| 200 # / Acre                       | 9.82  | 4.15               | 63  |       |                       |
| Shrub Density (# shrubs / 150 ft2) |       |                    |     |       |                       |
| 100 # / Acre                       | 5.81  | 4.74               | 118 |       |                       |
|                                    |       |                    |     | 0.960 | NS                    |
| 200 # / Acre                       | 6.33  | 4.00               | 147 |       |                       |

| Table 10,<br>Fertilizer Effect on Plant Growth on Subsoil. |       |                    |    |       |                       |
|--|-------|--------------------|----|-------|-----------------------|
| PARAMETER  | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)                                      |       |                    |    |       |                       |
| 100 # / Acre   | 12.25 | 3.23               | 20 |       |                       |
|  |       |                    |    | 0.949 | NS                    |
| 200 # / Acre   | 11.40 | 2.37               | 20 |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                  |       |                    |    |       |                       |
| 100 # / Acre   | 7.70  | 2.12               | 14 |       |                       |
|  |       |                    |    | 0.308 | NS                    |
| 200 # / Acre   | 7.97  | 2.69               | 16 |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )            |       |                    |    |       |                       |
| 100 # / Acre   | 8.65  | 5.14               | 37 |       |                       |
|  |       |                    |    | 1.980 | 0.10                  |
| 200 # / Acre   | 6.72  | 4.11               | 53 |       |                       |

| Table 11,<br>Fertilizer Effect on Plant Growth on Coal Refuse Plots. |       |                    |    |       |                       |
|--|-------|--------------------|----|-------|-----------------------|
| PARAMETER  | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)  |       |                    |    |       |                       |
| 100 # / Acre   | 14.66 | 6.28               | 32 |       |                       |
|  |       |                    |    | 0.536 | NS                    |
| 200 # / Acre   | 15.55 | 5.06               | 20 |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                            |       |                    |    |       |                       |
| 100 # / Acre   | 7.02  | 5.25               | 32 |       |                       |
|  |       |                    |    | 1.876 | 0.10                  |
| 200 # / Acre   | 9.56  | 5.14               | 27 |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )                      |       |                    |    |       |                       |
| 100 # / Acre   | 1.53  | 1.18               | 32 |       |                       |
|  |       |                    |    | 1.370 | NS                    |
| 200 # / Acre   | 2.19  | 2.38               | 27 |       |                       |

Table 12,  
Fertilizer Effect on Plant Growth on Topsoil.

| PARAMETER                          | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
|------------------------------------|-------|--------------------|----|-------|-----------------------|
| Total Plant Cover (%)              |       |                    |    |       |                       |
| 100 # / Acre                       | 19.39 | 7.85               | 13 |       |                       |
|                                    |       |                    |    | 1.002 | NS                    |
| 200 # / Acre                       | 16.75 | 4.79               | 12 |       |                       |
| Production (grams per 1/4m2)       |       |                    |    |       |                       |
| 100 # / Acre                       | 13.96 | 4.69               | 15 |       |                       |
|                                    |       |                    |    | 1.817 | 0.10                  |
| 200 # / Acre                       | 11.24 | 3.15               | 14 |       |                       |
| Shrub Density (# shrubs / 150 ft2) |       |                    |    |       |                       |
| 100 # / Acre                       | 6.47  | 3.93               | 49 |       |                       |
|                                    |       |                    |    | 1.019 | NS                    |
| 200 # / Acre                       | 7.19  | 3.29               | 54 |       |                       |

Table 13,  
Fertilizer Effect on Plant Growth on Topsoil Over Subsoil.

| PARAMETER                          | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
|------------------------------------|-------|--------------------|----|-------|-----------------------|
| Total Plant Cover (%)              |       |                    |    |       |                       |
| 100 # / Acre                       | 13.78 | 2.73               | 9  |       |                       |
|                                    |       |                    |    | 2.255 | 0.05                  |
| 200 # / Acre                       | 17.00 | 2.68               | 6  |       |                       |
| Production (grams per 1/4m2)       |       |                    |    |       |                       |
| 100 # / Acre                       | 8.16  | 3.41               | 5  |       |                       |
|                                    |       |                    |    | 2.897 | 0.05                  |
| 200 # / Acre                       | 12.60 | 1.49               | 6  |       |                       |
| Shrub Density (# shrubs / 150 ft2) |       |                    |    |       |                       |
| 100 # / Acre                       | -     | -                  | -  |       |                       |
|                                    |       |                    |    | -     | -                     |
| 200 # / Acre                       | 9.77  | 2.56               | 13 |       |                       |

| Table 14,<br>Fertilizer Effect on Plant Growth on Ten Inches of Subsoil. |       |                    |    |       |                       |
|--|-------|--------------------|----|-------|-----------------------|
| PARAMETER  | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)  |       |                    |    |       |                       |
| 100 # / Acre   | 12.00 | 2.59               | 12 |       |                       |
|  |       |                    |    | 0.000 | NS                    |
| 200 # / Acre   | 12.00 | 3.59               | 15 |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                                |       |                    |    |       |                       |
| 100 # / Acre   | 8.74  | 3.23               | 8  |       |                       |
|  |       |                    |    | 0.005 | NS                    |
| 200 # / Acre   | 8.73  | 1.63               | 8  |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )                          |       |                    |    |       |                       |
| 100 # / Acre   | 9.71  | 3.77               | 26 |       |                       |
|  |       |                    |    | 1.304 | NS                    |
| 200 # / Acre   | 11.18 | 4.26               | 25 |       |                       |

| Table 15,<br>Fertilizer Effect on Plant Growth on Twenty Inches of Subsoil. |       |                    |    |       |                       |
|---|-------|--------------------|----|-------|-----------------------|
| PARAMETER   | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)   |       |                    |    |       |                       |
| 100 # / Acre  | 10.50 | 1.77               | 8  |       |                       |
|   |       |                    |    | 2.424 | 0.05                  |
| 200 # / Acre  | 13.00 | 1.87               | 5  |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                                   |       |                    |    |       |                       |
| 100 # / Acre  | 7.21  | 1.93               | 8  |       |                       |
|   |       |                    |    | 0.837 | NS                    |
| 200 # / Acre  | 6.32  | 2.01               | 6  |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )                             |       |                    |    |       |                       |
| 100 # / Acre  | 3.83  | 1.56               | 27 |       |                       |
|   |       |                    |    | 0.884 | NS                    |
| 200 # / Acre  | 3.38  | 1.32               | 12 |       |                       |

| Table 16,<br>Fertilizer Effect on Plant Growth on Ten Inches of Topsoil. |       |                    |    |       |                       |
|--|-------|--------------------|----|-------|-----------------------|
| PARAMETER  | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)  |       |                    |    |       |                       |
| 100 # / Acre   | 26.67 | 4.68               | 6  |       |                       |
|  |       |                    |    | 2.250 | 0.05                  |
| 200 # / Acre   | 21.40 | 2.51               | 5  |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                                |       |                    |    |       |                       |
| 100 # / Acre   | 16.90 | 3.30               | 9  |       |                       |
|  |       |                    |    | 3.573 | 0.01                  |
| 200 # / Acre   | 10.58 | 3.44               | 6  |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )                          |       |                    |    |       |                       |
| 100 # / Acre   | 4.09  | 2.56               | 27 |       |                       |
|  |       |                    |    | 3.468 | 0.01                  |
| 200 # / Acre   | 6.72  | 2.99               | 27 |       |                       |

| Table 17,<br>Fertilizer Effect on Plant Growth on Twenty Inches of Topsoil. |       |                    |    |       |                       |
|---|-------|--------------------|----|-------|-----------------------|
| PARAMETER   | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)   |       |                    |    |       |                       |
| 100 # / Acre  | 13.14 | 2.54               | 7  |       |                       |
|   |       |                    |    | 0.206 | NS                    |
| 200 # / Acre  | 13.43 | 2.63               | 7  |       |                       |
| Production (grams per 1/4m <sup>2</sup> )                                   |       |                    |    |       |                       |
| 100 # / Acre  | 9.55  | 2.28               | 6  |       |                       |
|   |       |                    |    | 1.470 | NS                    |
| 200 # / Acre  | 11.74 | 3.05               | 8  |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )                             |       |                    |    |       |                       |
| 100 # / Acre  | 9.39  | 3.31               | 22 |       |                       |
|   |       |                    |    | 1.738 | 0.10                  |
| 200 # / Acre  | 7.67  | 3.55               | 27 |       |                       |

| Table 18,<br>Refuse Test Plots Conveyor Edge Effect. |       |                    |   |       |                       |
|--|-------|--------------------|---|-------|-----------------------|
| PARAMETER  | MEAN  | STANDARD DEVIATION | N | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)                                |       |                    |   |       |                       |
| Near   | 12.38 | 1.77               | 8 |       |                       |
|  |       |                    |   | 0.315 | NS                    |
| Away   | 12.75 | 2.87               | 8 |       |                       |
| Production (grams per 1/4m <sup>2</sup> )            |       |                    |   |       |                       |
| Near   | 8.73  | 2.26               | 8 |       |                       |
|  |       |                    |   | 0.437 | NS                    |
| Away   | 8.22  | 2.38               | 8 |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )      |       |                    |   |       |                       |
| Near   | 4.50  | 3.93               | 8 |       |                       |
|  |       |                    |   | 0.212 | NS                    |
| Away   | 4.88  | 3.09               | 8 |       |                       |

| Table 19,<br>Refuse Test Plots Aspect Comparison. |       |                    |    |       |                       |
|---|-------|--------------------|----|-------|-----------------------|
| PARAMETER   | MEAN  | STANDARD DEVIATION | N  | t-cal | LEVEL OF SIGNIFICANCE |
| Total Plant Cover (%)                             |       |                    |    |       |                       |
| North   | 12.00 | 3.59               | 15 |       |                       |
|   |       |                    |    | 4.111 | 0.001                 |
| South   | 18.40 | 4.14               | 10 |       |                       |
| Production (grams per 1/4m <sup>2</sup> )         |       |                    |    |       |                       |
| North   | 8.73  | 1.63               | 8  |       |                       |
|   |       |                    |    | 2.322 | 0.05                  |
| South   | 14.04 | 6.35               | 27 |       |                       |
| Shrub Density (# shrubs / 150 ft <sup>2</sup> )   |       |                    |    |       |                       |
| North   | 11.18 | 4.26               | 25 |       |                       |
|   |       |                    |    | 4.110 | 0.001                 |
| South   | 4.43  | 1.02               | 7  |       |                       |

Table 20,  
 Successfulness of Revegetation Efforts on Refuse Test Plots

| PLOT             | PERCENT<br>TOTAL COVER | PRODUCTION<br>(grams per 1/4m <sup>2</sup> ) | SHRUB DENSITY<br>(# shrubs/acre) |
|------------------|------------------------|--|----------------------------------|
| SUCCESS STANDARD | 22.00                  | 11.04  | 900 or 2200                      |
| A1               | 14.66 no               | 7.02 no                                      | 444 no                           |
| A2               | 15.55 no               | 9.56 yes                                     | 635 no                           |
| B1               | 10.50 no               | 7.21 no                                      | 1113 no                          |
| B2               | 13.00 no               | 6.32 no                                      | 980 no                           |
| C1               | 13.78 no               | 8.16 yes                                     | -                                |
| C2               | 17.00 no               | 12.60 yes                                    | 2837 yes                         |
| D1               | 12.00 no               | 8.70 yes                                     | 2820 yes                         |
| D2               | 12.00 no               | 8.73 yes                                     | 3247 yes                         |
| E1               | 13.14 no               | 9.55 yes                                     | 2726 yes                         |
| E2               | 13.43 no               | 11.74 yes                                    | 2227 yes                         |
| F1               | 21.40 yes              | 10.58 yes                                    | 1952 no                          |
| F2               | 26.67 yes              | 16.90 yes                                    | 1189 no                          |
| G                | 18.40 yes              | 14.04 yes                                    | 1328 yes                         |