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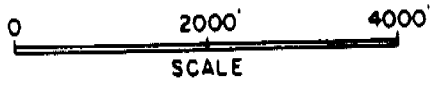
SPRING LOCATIONS IDENTIFIED FROM WATER RIGHT INFORMATION



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CASTLE GATE COAL COMPANY

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CASTLE GATE COAL COMPANY

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LOCATION OF HYDROLOGIC TEST WELLS

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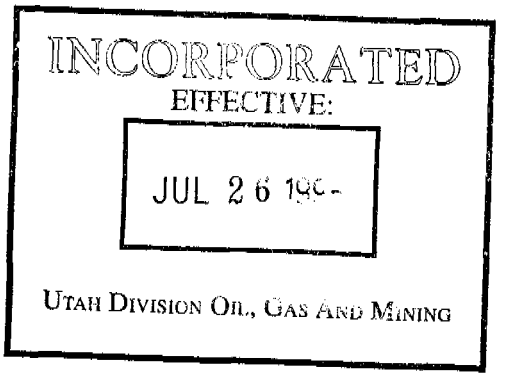
CHAPTER 8
SOIL RESOURCE

CASTLE GATE MINE
AMAX COAL COMPANY
Carbon County, Utah



April 1995

CHAPTER 8

SOIL RESOURCES

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CHAPTER 8

SOIL RESOURCES

8.1 GENERAL

The Mine Plan Area is at the juncture of three major physiographic sections in east-central Utah known as the Wasatch Plateau, the Book Cliffs, and the Mancos Shale Lowland. The soils of the area have been formed primarily by sedimentary bedrock weathering and colluvium from mixed sedimentary rocks. They vary in response to such host environments as geology, topography, climate, and vegetation. The general soil type characteristics of the physiographic sections are described below.

Soils of the Wasatch Plateau Section - The Mine Plan Area lies along the eastern front of the Wasatch Plateau. This portion of the plateau is steep, with high escarpment conditions. The area is mountainous and is characterized by steep cliffs and deeply incised drainages. The soils are rocky. Generally, the soils of this area are identified as high mountain types and are easily erodible if uncovered or disturbed.

Soils of the Book Cliffs Section - The soils of the Book Cliffs are derived from weathering of the steep, deeply dissected cliffs of the area. The soils have formed from sandstone and shales. They commonly have a silt loam to loam surface, with a loam to clay loam subsoil. Erosion potential is moderate.

Soils of the Mancos Shale Lowlands Section - The Mancos Shale Lowlands lie to the south of the junction between the Wasatch Plateau and the Book Cliffs, on the Mancos Shale Formation. The soils tend to be high in soluble salts and are generally a silty clay. Fertility is low. Due to the high clay content, they have a relatively high shrink-swell potential upon moisture content change. The soils in general are highly erodible.

Specific Soils Data in the Mine Plan Area - The General Soils Map for Carbon County Area, Utah (Figure 8-1) shows that the Castle Gate Mine plan area is located in three major soil mapping units (Soil Conservation Service (SCS) Soil Survey, Appendix 8-

1). The eastern part containing Price River canyon is in map unit No. 10, the Travessilla-Rock outcrop-Midfork family. The southwest part containing Hardscrabble Canyon and Sowbelly Gulch are in map unit No. 12, the Pathead-Curecanti family. Crandall Canyon to the north is located in map unit No. 15, the Senchert-Uinta family-Midfork family.

Soil map unit no. 10 is in a dry, subhumid climatic zone, whereas, the map units no. 12 and 15 are classified in a moist, subhumid climatic zone. The following descriptions of the soil map units are summarized from the Soil Survey of Carbon Area, Utah:

Map Unit

10 Travessilla-Rock outcrop-Midfork family. This map unit has shallow to very deep, well drained, steep and very steep soils, and Rock outcrop on mountain slopes and canyon sides. Elevation is 7,000 to 8,800 feet. Average annual precipitation is normally 14 to 18". This unit is about 30% Travessilla and similar soils, 25% Rock outcrop, and 10% Midfork family and similar soils. The remaining 35% is components of minor extent.

Travessilla soils are on mountain slopes and canyon sides that dominantly face south and west. These soils are shallow and well drained. They formed in residuum derived dominantly from sandstone. The surface layer is brown very gravelly fine sandy loam. Below this to a depth of 17" the soils are brown and light brown loam. Unweathered sandstone is at a depth of 10 to 20".

Rock outcrop consists of nearly barren exposures of sandstone, siltstone, and shale.

Midfork family soils are on mountain slopes that dominantly face north and east. These soils are very deep and well drained. They formed in colluvium derived dominantly from sandstone and shale. The surface is brown bouldery loam. Below this to a depth of 60" or more the soils are yellowish brown very gravelly loam.

Of minor extent in this unit are Gerst, Strych, Cabba family, Datino, Toze family, Rabbitex, Comodore, Rottulee, and Guben soils and Badland.

Map Unit 12

Pathead-Curecanti family - This map unit has moderately deep to very deep, well drained, very steep soils found on mountain slopes and canyon sides. Elevation is 6,800 to 9,000 feet and the average annual precipitation is about 16 to 20". This unit is about 45% Pathead and similar soils and 25% Curecanti family soils. The remaining 30 percent is components of minor extent.

Pathead soils are on mountain slopes and canyon sides. These soils are moderately deep and well drained. They formed in residuum and colluvium derived dominantly from sandstone and shale. the surface layer is brown extremely stony loam. Below this to a depth of 26" the soils are pale brown very cobbly loam. Unweathered sandstone is at a depth of 20 to 40".

Curecanti family soils are on mountain slopes. These soils are very deep and well drained. They formed in colluvium derived dominantly from sandstone and shale. The surface layer is dark grayish brown loam. The subsurface layer is very pale brown very stony loam. the subsoil to a depth of 60" or more is very pale brown very stony loam.Of minor extent in this unit are Rabbitex, Rottulee, Midfork family, Doney family, Senchert, and Pedo soils and Rock outcrop.

Map Unit 15

Senchert-Uinta family-Midfork family - This map unit has moderately deep to very deep, well drained, nearly level to very steep soils located mainly on mountaintops, mountain slopes and canyon sides. Elevation is 7,000 to 10,000 feet. Average annual precipitation is about 20 to 30 inches, and the soils are colder with an average annual air temperature of 34 to 38 degrees F.

This unit is about 30% Senchert and similar soils, 15% Uinta family and similar soils, and 10% Midfork family and similar soils. The remaining 45% is components of minor extent.

Senchert soils are on mountain slopes, benches, and plateaus. These soils are moderately deep and well drained. They formed in residuum and alluvium derived dominantly from sandstone and shale.

Uinta family soils are on mountain slopes and canyon sides. These soils are deep and well drained. they formed in colluvium derived dominantly from sandstone, siltstone, and shale. The surface layer is dark grayish brown

loam. The subsurface layer is light yellowish brown stony sandy loam. Unweathered sandstone is at a depth of 40 to 60".

Midfork family soils are on mountain slopes and canyon sides. These soils are very deep and well drained. They formed in colluvium derived dominantly from sandstone and shale. The surface layer is brown bouldery loam. Below this to a depth of 60" or more the soils are yellowish brown very gravelly loam.

Of minor extent in this unit are Beje, Doney, Podo, Perma, Datino, Croydon, Trag, Troze, Silas, Winetti, Shupert, and Comodore soils.

8.1-1 Soils Identification and Description

The Soil Survey Map for the total property (Exhibit 8-1) shows the location of the surface facilities in Crandall Canyon, Price River Canyon, Sowbelly Gulch, and Hardscrabble Canyon. It was compiled from soils maps contained in the Soil Survey of Carbon Area, Utah, published by the USDA Soil Conservation Service.

The soils legend on the map gives a listing of the soil mapping units included in the total Castle Gate property. The listing consists of both soil associations and soil complexes where the individual soil series are so intricately intermingled that it was not practical to map them separately at the scale used (1" = 1000').

A more detailed soil survey was conducted for the surface facilities areas during May, 1991. Leland Sasser, SCS Soil Scientist, identified individual soil series, where practical, for the surface facilities areas at a scale of 1" = 200'. The maps were prepared by D. S. Ralston, PhD, CPAg/SS, and were reviewed and approved by Mr. Sasser (Figure 8-2). The detailed soil survey maps will be discussed under the sections for individual facilities areas.

An earlier soil survey study was carried out by the consultants, Horrocks and Carollo of Salt Lake City in 1979. The consultants report presented below has been updated to be consistent with the published Soil Conservation Service soil maps. The consultants excavated 13 backhoe pits in five designated areas (Crandall Canyon, Willow

Creek, Castle Gate Preparation Plant area, Sowbelly area, and Hardscrabble area). The Willow Creek area has since been deleted from the permit.

In 1979 the soils in Crandall Canyon and on the mountain sides surrounding the individual study areas were essentially undisturbed, and hence, could be described as soils. The existing facilities areas consisted mostly of fill materials and were classified as made land.

8.1-2 Crandall Canyon

The Soil Survey Map for Crandall Canyon (Exhibit 8-2) shows the disturbed area for the existing surface facilities. The dominant soils on the south side of Crandall Canyon are the Midfork family and Comodore complex. Table 8-1A summarizes the characteristics of each soil and gives the family name. On the north side of the canyon, Pathead and Comodore are the dominant soils on the upper slopes, with Datino variant on the lower slopes. Uinta and Toze are mapped in the valley with the main difference being the presence of a calcium carbonate accumulation at about 24" in the Toze.

Where possible, the individual soil series were identified on the map. However, the soils are so intermingled in the complexes that further delineation was not practical. If specific soil areas are needed as borrow soils, further characterization will be done at the time of reclamation.

Pits 1, 2, and 3 shown on Exhibit 8-2 were excavated by the consultants in Crandall Canyon prior to installation of the surface facilities. The soils were initially described as Kornman (like). Since this mapping unit is no longer used in Carbon County, SCS has reclassified the three soil pits. Pits 1 and 3 are Shupert and pit 2 is Winetti.

Pit 1 - Lower part of the shaft site in Crandall Canyon area (Exhibit 8-2). Vegetation is grasses with some big sagebrush. The soil is formed in alluvium derived from mixed sedimentary rocks, mainly sandstone, shale, and limestone. The soil is well drained and has no appreciable amount of soluble salt, but has occasional boulders on the surface. Root penetration to a depth of 5 feet. The soil series for this pit is Shupert.

Soil Profile

A1 horizon, 0-4" - light brownish gray (10YR 6/2) loam having about 20 percent clay, dark grayish brown (10 YR 4/2) when moist; moderate medium platy structure; soft, friable, slightly sticky, slightly plastic; moderate effervescence with acid, mildly alkaline (pH 7.5); abrupt smooth lower boundary. No coarse fragments other than occasional boulders.

C1 horizon, 4 to 9" - light brownish gray (10YR 6/2) gravelly fine sand, having about 5 percent clay, dark grayish brown (10YR 4/2) when moist; single grain, loose, non sticky, nonplastic; moderate effervescence with acid; mildly alkaline (pH 7.5); abrupt smooth lower boundary. Soil has about 20 percent gravel.

C2 horizon, 9 to 27" - light brownish gray (10YR 6/2) sandy loam having about 10 percent clay, dark grayish brown (10YR 4/2) when moist; massive, soft, very friable, slightly sticky, nonplastic; strong effervescence with acid; mildly alkaline (pH 7.5): abrupt smooth lower boundary. Soil has no coarse fragments

C3 horizon, 27 to 35" - light brownish gray (10YR 6/2) clay loam having about 29 percent clay, dark grayish brown (10YR 5 4/2) when moist; massive; hard, firm, sticky and plastic; strong effervescence; mildly alkaline (pH 7.5); clear smooth lower boundary. No coarse fragments.

C4 horizon, 35 to 37" - light brownish gray (10YR 6/2) sandy loam having about 9 percent clay, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, slightly sticky, nonplastic; strong effervescence; mildly alkaline (pH 7.5); abrupt smooth lower boundary. No coarse fragments.

C5 horizon, 27 to 40" - light brownish gray (10YR 6/2) gravelly, loamy sand, having about 5 percent clay, dark grayish brown (10YR 4/2) when moist; single grain, loose nonsticky, plastic; strong effervescence; abrupt smooth lower boundary. Soil has about 20 percent coarse fragments.

C6 horizon, 40 to 50" - light brownish gray (10YR 6/2) loamy sand having about 5 percent clay, dark grayish brown (10YR 4/2) when moist; massive, loose, nonsticky, nonplastic; strong effervescence; abrupt smooth lower boundary. No coarse fragments.

A1b horizon, 50 to 53" - very dark gray (2.5Y 3/1) loam, having about 25 percent clay, black (2.5Y 2/10) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; strong effervescence; abrupt smooth lower boundary. No coarse fragments.

C7b horizon, 53 to 58" - light brownish gray (10YR 6/2) sand having about 5 percent clay, dark grayish brown (10YR 4/2) when moist; single grain; loose, nonsticky, nonplastic; violent effervescence; abrupt smooth lower boundary. No coarse fragments.

IIA1b horizon, 58 to 67" - very dark gray (2.5Y 3/1) loam having about 25 percent clay, black (2.5Y 2/1) when moist; massive, soft friable, slightly sticky, slightly plastic, moderate effervescence.

Pit 2 - Upper end of the proposed shaft site in Crandall Canyon (Exhibit 8-2). Native vegetation is big sagebrush, cottonwood, yellowbrush and grasses. Climate is semi-desert, soil forming in alluvium derived from mixed sedimentary rocks (sandstone, shale and limestone) in a stream bottom. It is well drained on east facing 3 percent slope. Roots penetrate to 5 feet. Erosion is slight and permeability moderate. The soil series for this pit is Winetti.

Soil Profile

A1 horizon, 0 to 5" - light brownish gray (10YR 6/2) sandy loam having about 15 percent clay, dark grayish brown (10YR 4/2 when moist; moderate medium platy structure; soft, very friable, slightly sticky, nonplastic; strong effervescence with acid; mildly alkaline (pH 7.5); abrupt smooth lower boundary. About 15 percent coarse fragments, mostly boulders.

C1 horizon, 5 to 17" - light brownish gray (10YR 6/2) loam having about 22 percent clay, dark grayish brown (10YR 4/2) when moist; massive, hard, friable, slightly sticky, slightly plastic, violent effervescence, abrupt smooth lower boundary. About 15 percent boulders.

C2 horizon, 17 to 26" - light brownish gray (10YR 6/2) very gravelly, sandy loam with about 17 percent clay, dark grayish brown (10YR 4/2) when moist; massive; hard, very friable, nonsticky, nonplastic; violent effervescence; clear wavy lower boundary. Soil contains about 60 percent coarse fragments, of which about 15 percent are boulders.

C3 horizon, 26 to 32" - light brownish gray (10YR 6/2) light sandy loam with about 12 percent clay, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky; nonplastic; violent effervescence; abrupt smooth lower boundary. Soil contains about 15 percent boulders.

A1 horizon, 32 to 46" - dark gray (2.5Y 4/1) sandy loam with about 10 percent clay, very dark gray (2.5Y 3/1) when moist; massive, slightly hard, friable, slightly sticky, slightly plastic; strong effervescence, gradual wavy lower boundary. Horizon has about 30 percent stone and boulders.

C4h horizon, 46 to 89+" - light brownish gray (10YR 6/2) very stony sandy loam with about 15 percent clay, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, slightly sticky; nonplastic coarse fragments make up 80 percent of horizon and consist of stones and boulders.

Pit 3 - Two hundred feet west of Pit 2, on an alluvial fan in Crandall Canyon (Exhibit 8-2). Vegetation consists of big sagebrush, stipa, houndstongue and snowberry. Climate is semi-desert. Slope is about 6 percent Roots penetrate to 6 feet. The soil series for this pit is Shupert.

Soil Profile

01 horizon, 0 to 3" - litter.

A1 horizon, 0 to 7" - light brownish gray (10YR 6/2) loam, with about 22 percent clay, dark grayish brown (10YR 4/2) when moist; with about 22 percent clay, dark grayish brown (10YR 4/2) when moist; moderate, medium platy structure, slightly hard, friable, slightly sticky, slightly plastic, strong effervescence with acid, mildly alkaline (pH 7.5); clear wavy lower boundary. Horizon has 5 percent coarse fragments.

C1 horizon, 7 to 13" - light brownish gray (10YR 6/2) sandy loam, having about 15 percent clay, dark grayish brown (10YR 4/2) when moist; weak platy structure, soft, friable, slightly sticky, nonplastic; strong effervescence; mildly alkaline (pH 7.5); gradual wavy lower boundary.

C2 horizon, 13 to 80+" - this consists of stratified layers of sandy loam and light loam textures, each ranging from 2 to 4" thick. Colors are the same as the C1 horizon. The sandy loam layers are massive; loose, very friable, nonsticky, nonplastic; violent effervescence. They have about 10 percent stones. The light loam layers are massive, slightly hard, very friable, slightly sticky, slightly plastic; moderate effervescence. They have about 15 percent stones. There is evidence of a buried A1 horizon at 72 inches.

8.1-3 Castle Gate Preparation Plant Area

The detailed soil survey map for the Castle Gate Preparation Plant facilities is presented in Exhibit 8-4. The dominant soils are listed in Table 8-1B. The mountains to the north and east of Price River canyon have Travessilla soils and Rock Outcrop on the upper slopes and Strych and Guben soils on the lower slopes. Shupert and Winetti are the alluvial soils in the valley. Pathead and Doney family are the dominant soils to the west of U.S. Highways 6 and 50.

The disturbed area for the preparation plant facilities, including Schoolhouse Canyon refuse disposal area, is shown on Exhibit 8-4. Soil pits 6 through 10 were excavated by Horrocks and Carollo in the made land disturbed area.

Pit 6 - Pit 6 is about 400 feet east of power substation in a canyon area that has been filled (see Exhibit 8-4). The outer edge has been filled with trash. The pit in the south part showed the fill consisted of about 60 percent cobble and stones with loam, soil, bottles, wire, and other trash. The mountain north of Pit 6 is Travessilla on the upper slopes and Strych developed in the colluvium on the lower slopes. The mountain to the south is Strych on the lower slopes (with very strong, sandy loam on the colluvial cones) and Travessilla (extremely rocky, very fine, sandy loam soil in areas where rock outcrops are visible.) Strych soils are described as follows:

Soil Profile

A1 horizon, 0 to 7" - pale brown (10YR 6/3) very stony sandy loam, dark brown (10YR 4/3) when moist; moderately fine, granular structure; soft, very friable, slightly sticky and slightly plastic; few large, plentiful medium and fine roots; no pores, strongly calcareous, mildly alkaline (pH 7.7); clear, smooth boundary.

C1ca horizon, 7 to 13" - very pale brown (10YR 7/3) stony sandy loam, pale brown (10YR 6/3) when moist; weak, medium to coarse, angular blocky structure. Slightly hard, very friable, slightly sticky and slightly plastic; few medium and fine pores, very strongly calcareous, moderately alkaline (pH 8.0), wavy, gradual boundary.

C2 horizon, 13 to 21" - pale brown (10YR 6/3) stony sandy loam, brown (10YR 5/3) when moist; weak, medium to coarse, angular blocky structure, slightly hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; common fine and a few medium pores, strongly calcareous, moderately alkaline (ph 8.2); gradual, wavy boundary.

C3 horizon, 21 to 34" - pale brown (10YR 6/3) stony sandy loam, brown (10YR 5/3) when moist; massive, hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; few fine pores, strongly calcareous; strongly alkaline (pH 8.5).

Stones and cobblestones ranging from 3" to 4' in diameter to occupy from 0.1 to 3.0 percent of the surface. Limey horizons are within 3 to 9" of the surface.

Pit 7 - North end of preparation plant area. Made land. A barren fill area of made land (Exhibit 8-4).

0 to 23" - filled material consisting of light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) when moist mixed with about 50 percent stones. The stones consist of sandstone, siltstone and coal.

23 to 52" - fill material, mainly coal dust, shale, sandstone and quartzite rocks with about 30 percent soil, 30 percent rocks and 40 percent coal.

50 to 80" - light brown (10YR 6/3) gravelly clay, brown (10YR 4/3) when moist. This layer has about 40 percent clay in the soil material and appears to be part of the undisturbed volume.

Pit 8 - North end of preparation plant about 100 feet south of open water storage reservoir (Exhibit 8-4) It is a barren coal storage area.

0 to 58" - consists of fill material made up of 50 percent stones and boulders mixed with loam textured soil. Trash such as concrete pieces, wire and cable are in this layer.

58 to 78" - consists of loamy sand with no coarse fragments.

78 to 88" - consists of very cobbly loamy sand (about 60 percent cobble).

Pit 9 - 150 feet south of stockpile soil (preparation plant, Exhibit 8-4). This is made land - mostly fill.

0 to 15" - dark grayish brown (1pYR 4/2) very gravelly sandy loam mixed with coal dust (50 percent gravel).

15 to 55" - pinkish gray (7.5YR 6/2) clay loam, brown (7.5YR 4/2) when moist, interlayered stony loam, black (10 YR 2/1) when moist. Stones make up about 30 percent of the volume.

55 to 95" - consists of coal dust and clinkers mixed with a little loam soil and cobble. About 40 percent is cobble. Steep slopes to the east are Travessilla soils with inclusions of Strych and Gerst.

Pit 10 - East of road. (Preparation plant area, Exhibit 8-4). Vegetation consists of annual weeds. This small area has been filed and consists of the following:

0 to 7" - light brownish gray (10YR 6/2) loamy sand with about 5 percent clay.

7 to 55" - interlayered soil, coal and sand with 50 percent cobble and lumps of coal. The soil is sandy loam.

55 to 90" - consists of loamy sand with about 4 percent clay and no coarse fragments.

8.1-4 Sowbelly Gulch Area

The Soil Survey Map for Sowbelly Gulch area is presented in Exhibit 8-5. The dominant soils are listed in Table 8-1C. Loamy-skeletal Pathead is the dominant soil between the rock outcrops on the upper slopes, and Curecanti is formed in colluvium on the lower slopes. Travessilla, a shallow soil developed primarily in sandstone residuum, is found on some of the north slopes of the canyon. Areas disturbed by mining activities are shown on the map as made land (M3).

Pit 11 - As shown on Exhibit 8-5, Pit 11 is located at the upper end of the Sowbelly area. This area consists mainly of fill material.

0 to 8" - light brownish gray (10YR 6/2) very stony loam, very dark grayish brown (10YR 3/2) when moist; weak coarse platy structure; very hard, friable, slightly sticky, slightly plastic; about 50 percent stones and cobble.

8 to 95" - light brownish gray (10YR 6/2) very stony loam, dark grayish brown (10YR 4/2) when moist, massive; extremely hard, friable, slightly sticky, slightly plastic, violent effervescence. This layer is about 50 percent stones and boulders. This material would be good for foundations for low buildings and would be good for septic tanks and filter fields.

Pit 12 - Sowbelly - 50 feet south of west end of trailers, made land and parking lot.

0 to 8" - light gray (2.5Y 7/2) very gravelly sandy loam. Sandy loam soil has about 15 percent clay and is very hard. This layer has about 50 percent gravel.

8 to 88" - light brownish gray (10Y 7/2) very cobbly loam (loam soil has about 25 percent clay) dark grayish brown (10YR 4/2) when moist; very hard, friable, slightly sticky, slightly plastic. This layer has about 50 percent coarse fragments, mainly cobble and stones. M3 material would be good foundation material and would be suitable for septic tanks and filter fields with proper field drains.

8.1-5 Hardscrabble Canyon Area

The detailed soils map for Hardscrabble Canyon is presented in Exhibit 8-6. The dominant features of the soils are listed in Table 8-1C. The soils of Hardscrabble Canyon and the same as for Sowbelly Gulch located just to the west. Pathead is found on the upper slopes and Curecanti developed on the lower slopes. Travessilla is generally found on the south facing slopes between rock outcrops. Datino and Comodore are colder soils found on the north facing slopes. Disturbed soils are shown as made land (M4).

Pit 13 - This pit is located near the old loadout facilities in the Hardscrabble area (Exhibit 8-6). It is a fill area consisting of made land #4 (M4).

0 to 3" - coal mixed with a small amount of soil.

3 to 55" - light reddish brown (5YR 6/3) very cobbly sandy loam, reddish brown (5YR 5/4) when moist; extremely hard, very friable, slightly sticky, nonplastic. This layer has about 65 percent cobble, stone and boulders, 25 percent gravel, and 10 percent sandy loam soil.

55 to 64" - this buried A1 horizon is brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) when moist; massive; hard, friable, slightly sticky, slightly plastic, and is about 10 percent gravel.

C1b horizon, 64 to 80" - brown (7.5YR 5/4) very gravelly loam; brown (7.5YR 4/4) when moist; massive, hard, friable, slightly sticky, slightly plastic. This layer is 50 percent gravel and cobble.

8.1-6 Present and Potential Production

The estimated total production for the dominant soil mapping units associated with the surface facilities sites are presented in Table 8-2 (source SCS Soil Survey). Total annual production for normal years ranges from 75 pounds/acre for Midfork and Comodore to 1,500 pounds/acre for Winetti. In dry years, map unit No. 121, Travessilla and Gerst, will produce about 300 pounds per acre, and map unit No. 72, Pathead and Curecanti, will produce 600 to 1000 pounds per acre.

Gerst (formally Castle Valley) soil produces 327 pounds air dry herbage per acre, 29 percent from bluegrass, 55 percent from pinyon-juniper, 16 percent from dryland sedge, bluebunch wheatgrass, penstemon, mat buckwheat, hairgolden aster, rock goldenrod, woody phlox, and shadescale. The potential plan cove is about 57 percent pinyon-juniper and 40 percent Indian ricegrass, bluegrass, galletagrass, perennial mustard, senecio, milkweed, birchlead mahogany, prickly pear, Mormon tea, and forage per acre in favorable

year and 100 pounds per acre in less favorable years. This soil is a semi-desert stony hills range site.

Shupert (formally Korman like) soil. This soil has a total potential production of 950 pounds per acre of air dry forage in favorable years and of 550 pounds per acre in unfavorable years. Vegetation consists of needle-and-thread, squirreltail, winterfat, bud sagebrush and big sagebrush. In its present condition, it produces about 60 percent of its potential. This soil is in a semi-desert loam, bench range site.

Strych-Gerst (formally Kenilworth-Castle Valley) soils. The Gerst soils produce essentially the same as that described above. The Strych soils, in potential condition, have an overstory of pinyon and juniper. The understory consists of 85 percent Indian Ricegrass. The remainder is squirreltail, needle-and-thread, bullgrass, and sand dropseed (5 percent); birchleaf mahogany, bitterbrush, cliffrose, Mormon tea and mockorange (5 percent); phlox, scarlet globemallow, penstemon, locoweed, and aster (5 percent). It produces 1,250 pounds of forage per acre in good years and 900 pounds in less favorable years.

For additional information on production see Chapter 9.

8.2 PRIME FARMLAND INVESTIGATION

Based on the results of this investigation, a negative determination is requested for the affected surface lands within the Mine Plan Area. This request is based on the following reasons:

1. The land has not been historically used as crop land.
2. The slope of the affected areas is generally greater than 4 percent.
3. The land is not irrigated.
4. The land is very rocky and is generally not conducive to agricultural development.

A letter from the SCS provided a negative prime farmland determination. A copy of this letter dated 05-21-91 is included as Figure 8-3.

8.3 REMOVAL, STORAGE, PROTECTION, TESTING, AND REDISTRIBUTION OF SOILS

Topsoil handling operations will adhere to requirements of R645-301-200. Removal and storage of soil materials will occur in areas needed for mining activities, where it is shown to exist in an uncontaminated and accessible condition (see Exhibit 8-10). Surface facilities in use prior to 1977 have no available topsoil. Steep slopes severely limit soil removal operations. Resoiling materials for these areas will be obtained by finding and testing suitable alternate resoiling materials. All stockpiled resoiling materials will be protected from wind and water erosion by various means, depending on season, and will include:

1. Diverting runoff away from storage areas.
2. Locating of storage piles in the most naturally protected areas available.
3. Seeding, mulching, crimping, and in extreme circumstances, jute matting.

Any in situ removal of soil materials, soil to be purchased, or alternate resoiling materials will be subjected to chemical and physical tests. The tests will be used to determine the nutrient availability and texture class. The frequency of the testing associated with soil movement in each mine area is identified in Chapter 3, under the section corresponding to that mine area. The specific tests to be performed on the soils are identified in Chapter 3. Based on results of these tests, soil amendments or surficial alternations may be applied to the stockpiles for the promotion of rapid plant growth. Results of previous tests performed on resoiling materials can be found in Appendix 8-2.

8.4 SOIL RESOURCES, GRADING, AND RECLAMATION ASPECTS

8.4-1 General

As mentioned previously, there are insufficient resoiling materials at most of the Castle Gate Coal Mine sites due to the pre-law (pre-SMCRA) operations, when salvage of resoiling materials was not required. The exception is Crandall Canyon, where materials

derived during site development were salvaged for resoiling. Section 3.7 contains the reclamation plan for Crandall Canyon. For the remaining areas, several methods are used to address the resoiling materials deficit.

To the maximum extent possible, the existing soils found in the pre-SMCRA disturbed areas will be utilized during reclamation as fill against cut slopes and as substitute topsoil. Where there is insufficient material to completely cover all the cut slopes, some of the rock exposed by the mining operations will remain exposed. This situation occurs in Sowbelly Canyon, Hardscrabble Canyon, and the Preparation Plant site. Finally, where additional material is needed to complete the reclamation plan grading, it will be transported from the Gravel Canyon site. Most of the soil available for use as fill and substitute topsoil in Gravel Canyon is allocated for use as cover for the Refuse Disposal Site. Specifics of the reclamation plan for each mine area are contained in the appropriate section of Chapter 3.

The substitute topsoil for each mine area will be analyzed as described in the reclamation plan for each disturbed area. Based on results of these physical and chemical tests, soil amendments or surficial alternations may be applied to the soils for the promotion of rapid plant growth.

8.4-2 Topsoil and Refuse Pile Covering Material Centralized Storage Site: Gravel Canyon

8.4-2(1) Site Description

Gravel Canyon is located on the west side of State Highway 6 across Price Canyon from the preparation plant. The entire canyon is a fee property beyond the 100' highway right-of-way line. This is a typical steep sided canyon with an initially steep profile tapering to the broad, relatively flat canyon mouth. A complete description of the site is contained in Section 3.6.

8.4-2(2) Site Development

An ancillary road and several drainage control structures currently exist in Gravel Canyon. A description of these features, and the entire operational hydrology plan, is contained in Section 3.6.

8.4-2(3) Soil Materials Protection

A chain link fence and gate will be installed to limit access if unauthorized borrow becomes a problem. All materials were seeded with plant species of both annual and perennial habit in the fall of 1982. The seed mix used was:

Great Basin Wildrye	Elymus cinereus	5 pounds
Great Needlegrass	Stipa viridula	4 pounds
Indian Ricegrass	Oryzopsis hymenoides	3 pounds
White Sweet Clover	Melilotus alba	5 pounds

Rates are for pure live seed.

8.4-2(4) Final Site Reclamation

Gravel Canyon will not be reclaimed until the grading and topsoil placement for all remaining areas of the mine are completed. The reclamation plan developed for Gravel Canyon maximizes the amount of soil that can be removed from the site for use as cover and substitute topsoil for the other mine areas, while limiting the grade of the finished slopes in Gravel Canyon to 2 horizontal to 1 vertical (2:1) or less. Once rough grading of the disturbed area of Gravel Canyon is complete, the top 6 inches of soil will be considered substitute topsoil, and will be tested for suitability as a plant growth medium. The area will be vegetated using methods described in Chapter 9. A complete description of this plan, and the associated mass balance, is contained in Section 3.6.

8.5 PREPARATION FOR TOPSOIL PLACEMENT - SITE GRADING

8.5-1 General

Upon completion of the reclamation rough grading, the soils at each mine area will be prepared to receive the appropriate seed mixture. If topsoil material is available, the soils constituting the rough grade will be scarified prior to placement of the topsoil. If topsoiling material is not available, the soils used as fill will be considered substitute topsoil. In this case, the top layer of fill will be left uncompacted to create a more productive growing medium. Details of preparation for topsoil placement for each mine area are contained within Sections 3.2 through 3.7.

8.5-2 Refuse Disposal Pile Covering

Coal waste, coal refuse, coal spilled during handling operations, and sediment removed from the sediment ponds will be hauled to the Refuse Disposal Facility in School House Canyon. If deemed necessary, these materials will be treated to neutralize toxicity, and protected from upward migration of salt, and amended to provide an adequate medium for plant growth. The hydrology control plan, as described in Section 3.4, currently protects the materials in the pile from erosion and the formation of acid or toxic seeps.

Refuse materials at the Castle Gate Coal Mine have been found to be non-toxic and non-acid forming. These materials are composed of rock and rock fines derived from the roof and floor of both No. 3 and No. 5 mines. Table 8-3 and Appendix 8-2 outline the results of various laboratory analyses performed since 1980.

Due to the apparent non-toxicity of refuse materials, reclamation of the Refuse Disposal Facility will entail covering the refuse with 2 feet of designated resoiling materials. A complete reclamation plan for the Refuse Disposal Facility is included in Section 3.4.

CGSOILT3
7/18/91

(Revised 7/91)

Table 8.1a – Dominant Soils in Crandall Canyon

Map Unit	Soil Name	Family	Normally Found	Dominant Features
24	Datino Variant	Typic Haploborolls	Mountain toe slopes	Very deep soil developed in sandstone & shale collumium – colder soil Very stony loam, 50–80% slopes
62	Midfork family	Typic Cryoborolls	Mountain slopes	Deep, loamy–skeletal soils formed in gravelly colluvium from calcareous sedimentary rock.
	Comodore complex	Lithic Haploborolls	Mountain slopes	Shallow, loamy–skeletal soils formed in sandstone colluvium. Bedrock @ 10–20".
71	Pathead	Typic Ustorthents	Mountain slopes & canyon sides	Extremely bouldery f. sandy loam soil formed in sandstone and shale colluvium.
	Rock Outcrop	Inclusion in map unit	Mid to upper slopes	Exposed sandstone & siltstone in sandstone & shale colluvium
72	Pathead	Typic Ustorthents	Ridges & upper slopes	Loamy–skeletal soils formed in sandy colluvium
	Curecanti	Typic Argiborolls	Lower slopes	Very deep, well drained soils formed in sandstone & shale colluvium
	Rock Outcrop	Inclusion in map unit	Mid to upper slopes	Exposed sandstone & siltstone in sandstone & shale colluvium
125	Uinta	Typic Cryoboralfs	Lower slopes and narrow valleys	Deep soil developed in colluvium derived from sandstone and shale
	Toze	Calcic Pachic Cryoborolls	Lower slopes and narrow valleys	Very deep soil developed in sandstone siltstone & shale colluvium. Calcium carbonate accumulation at 24".

REVISED SEP 1991

CGSOILT2
5/29/91

Table 8.1b – Dominant Soils in Castle Gate Preparation Plant Site

Map Unit	Soil Name	Family	Normally Found	Dominant Features
26	Doney family	Typic Ustochrepts	Mountain slopes S & W aspects	Mod. deep developed in residuum and colluvium from siltstone & shale
47	Guben	Typic Calciborolls	Mountain slopes	Loamy–skeletal soils formed in colluvium from sandstone and shale
	Rock Outcrop		Mid to upper slopes	Exposed sandstone & siltstone
72	Pathead	Typic Ustorthents	Ridges & upper slopes	Loamy–skeletal soils formed in sandy colluvium
	Curecanti	Typic Argiborolls	Lower slopes	Very deep, well drained soils formed in sandstone & shale colluvium
	Rock Outcrop	Inclusion in map unit	Mid to upper slopes	Exposed sandstone & siltstone
107	Shupert	Typic Ustifluvents	Narrow valley & canyon floors	Very deep soils developed in alluvium derived from sandstone & shale
	Winetti	Ustic Torriorthents	Alluvial fans	Very deep soils formed in alluvium derive for mixed sedimentary rock
121	Travessilla	Ustic Torriorthents	Canyonsides	Shallow soil developed primarily in sandstone residuum
	Rock Ourcrop		Mid to upper slopes	Exposed sandstone and siltstone
	Gerst	Ustic Torriorthents	Canyonsides S & W aspects	Shallow soil developed primarily in shale residuum
	Strych	Ustollic Calciorthids	Lower slopes	Loamy–skeletal, deep soil formed in sandstone & shale colluvium

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CGSOILT1
5/29/91

Table 8.1c – Dominant Soils in Sowbelly Gulch and Hardscrabble Canyon Sites

Map Unit	Soil Name	Family	Normally Found	Dominant Features
72	Pathead	Typic Ustorthents	Ridges & upper slopes	Loamy–skeletal soils formed in sandy colluvium
	Curecanti	Typic Argiborolls	Lower slopes	Very deep, well drained soils formed in sandstone & shale colluvium
	Rock Outcrop	Inclusion in map unit	Mid to upper slopes	Exposed sandstone & siltstone
121	Travessilla	Ustic Torriorthents	canyonsides	Shallow soil developed primarily in sandstone residuum
	Rock Ourcrop		Mid to upper slopes	Exposed sandstone and siltstone
	Gerst	Ustic Torriorthents	canyonsides S & W aspects	Shallow soil developed primarily in shale residuum
	Strych	Ustollic Calciorthids	Lower slopes	Loamy–skeletal, deep soil formed in sandstone & shale colluvium
20	Comodore	Lithic Haploborolls	N & E facing side slopes	Shallow soil over sandstone & shale colluvium – colder soil
	Datino Variant	Typic Haploborolls	N & E facing toe slopes	Very deep soil developed in sandstone & shale collumium – colder soil
126	Winetti Variant	Typic Ustifluvents	Narrow valley& canyon floors	Very deep soils formed in alluvium from sandstone & shale

TABLE 8-2 SUBMITTED SEP 1991

Rangeland and Woodland Understory Productivity for Dominant Soils —Continued

Soil name and map symbol	Grazing site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
72*:					
Pathead	Mountain Very Steep Loam (Saline Wildrye).	Favorable	1,400	Salina wildrye	35
		Normal	1,200	Snowberry	10
		Unfavorable	1,000	Bluegrass	5
				Bluebunch wheatgrass	5
				Needlegrass	5
				Prairie junegrass	5
				Birchleaf mountainmahogany	5
				Antelope bitterbrush	5
				Utah serviceberry	5
				Indian ricegrass	5
Curecanti	Mountain Very Steep Loam (Oak).	Favorable	1,400	Gambel oak	30
		Normal	1,000	Bluegrass	10
		Unfavorable	600	Snowberry	10
				Wheatgrass	5
				Serviceberry	5
				Mountain big sagebrush	5
107*:					
Winetti	Loamy Bottom	Favorable	2,000	Basin wildrye	25
		Normal	1,500	Basin big sagebrush	15
		Unfavorable	1,000	Needleandthread	10
				Western wheatgrass	10
				Muttongrass	10
				Indian ricegrass	5
				Rubber rabbitbrush	5
121*:					
Travessilla	Upland Very Steep Shallow Loam (Pinyon-Utah Juniper)**.	Favorable	700	Salina wildrye	20
		Normal	500	Indian ricegrass	10
		Unfavorable	300	Birchleaf mountainmahogany	10
				Utah serviceberry	10
				Bluegrass	5
				Needleandthread	5
				Bluebunch wheatgrass	5
				Mormon-tea	5
				Antelope bitterbrush	5
Rock outcrop.					
Gerst	Semidesert Very Steep Shallow Clay (Utah Juniper)**.	Favorable	600	Shadscale	30
		Normal	500	Salina wildrye	25
		Unfavorable	350	Galleta	10
				Bluebunch wheatgrass	10
				Western wheatgrass	5
125*:					
Uinta	High Mountain Very Steep Stony Loam (Engelmann Spruce)**.	Favorable	100	Blueberry	50
		Normal	75	Oregon-grape	15
		Unfavorable	50	Sedge	10
				Pinegrass	10
				Currant	10
Toze	High Mountain Very Steep Stony Loam (Engelmann Spruce)**.	Favorable	100	Blueberry	50
		Normal	75	Oregon-grape	15
		Unfavorable	50	Sedge	10
				Pinegrass	10
				Currant	10
126 Winetti Variant	Loamy Bottom	Favorable	2,000	Basin wildrye	25
		Normal	1,500	Basin big sagebrush	15
		Unfavorable	1,000	Needleandthread	10
				Western wheatgrass	10
				Muttongrass	10
				Indian ricegrass	5
				Rubber rabbitbrush	5

Source: Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service. 1988.

TABLE 8-2 SUBMITTED SEP 1991

RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY FOR DOMINANT SOILS

(Only the soils that support rangeland vegetation suitable for grazing are listed. Two asterisks identifies a woodland site that supports grazeable understory)

Soil name and map symbol	Grazing site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
20*: Comodore	Mountain Very Steep Stony Loam (Douglas-fir)**.	Favorable Normal Unfavorable	700 500 400	Salina wildrye Snowberry Slender wheatgrass Elk sedge Indian ricegrass Birchleaf mountainmahogany Rocky Mountain juniper	15 15 10 5 5 5 5
24 Datino Variant	Mountain Very Steep Loam (Oak).	Favorable Normal Unfavorable	1,400 1,000 600	Gambel oak Bluegrass Snowberry Wheatgrass Serviceberry Mountain big sagebrush	30 10 10 5 5 5
26* Doney	Mountain Very Steep Loam (Saline Wildrye).	Favorable Normal Unfavorable	1,400 1,200 1,000	Salina wildrye Snowberry Bluebunch wheatgrass Prairie junegrass Bluegrass Birchleaf mountainmahogany Antelope bitterbrush Utah serviceberry	35 10 5 5 5 5 5 5
47*: Guben	Mountain Very Steep Stony Loam (Douglas-fir)**.	Favorable Normal Unfavorable	700 500 400	Salina wildrye Snowberry Wheatgrass Elk sedge Indian ricegrass Birchleaf mountainmahogany Rocky Mountain juniper	15 15 10 5 5 5 5
62*: Midfork	High Mountain Very Steep Loam (Douglas-fir)**.	Favorable Normal Unfavorable	100 75 50	Snowberry Oregon-grape Mountainlover Quaking aspen Sedge Bluegrass Needlegrass Wheatgrass	10 10 10 10 5 5 5 5
Comodore	High Mountain Very Steep Loam (Douglas-fir)**.	Favorable Normal Unfavorable	100 75 50	Snowberry Oregon-grape Mountainlover Quaking aspen Sedge Bluegrass Needlegrass Wheatgrass	10 10 10 10 5 5 5 5
71 Pathead	Mountain Very Steep Stony Loam (Curlleaf Mountainmahogany).	Favorable Normal Unfavorable	1,100 800 600	Curlleaf mountainmahogany Salina wildrye Utah serviceberry Snowberry Indian ricegrass Wheatgrass	30 20 5 5 5 5

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TABLE 8-3

COMPARISON OF CHEMICAL ANALYSES OF COAL REFUSE AND ROCK WASTE IN HARDSCRABBLE CANYON AT GOOSE ISLAND

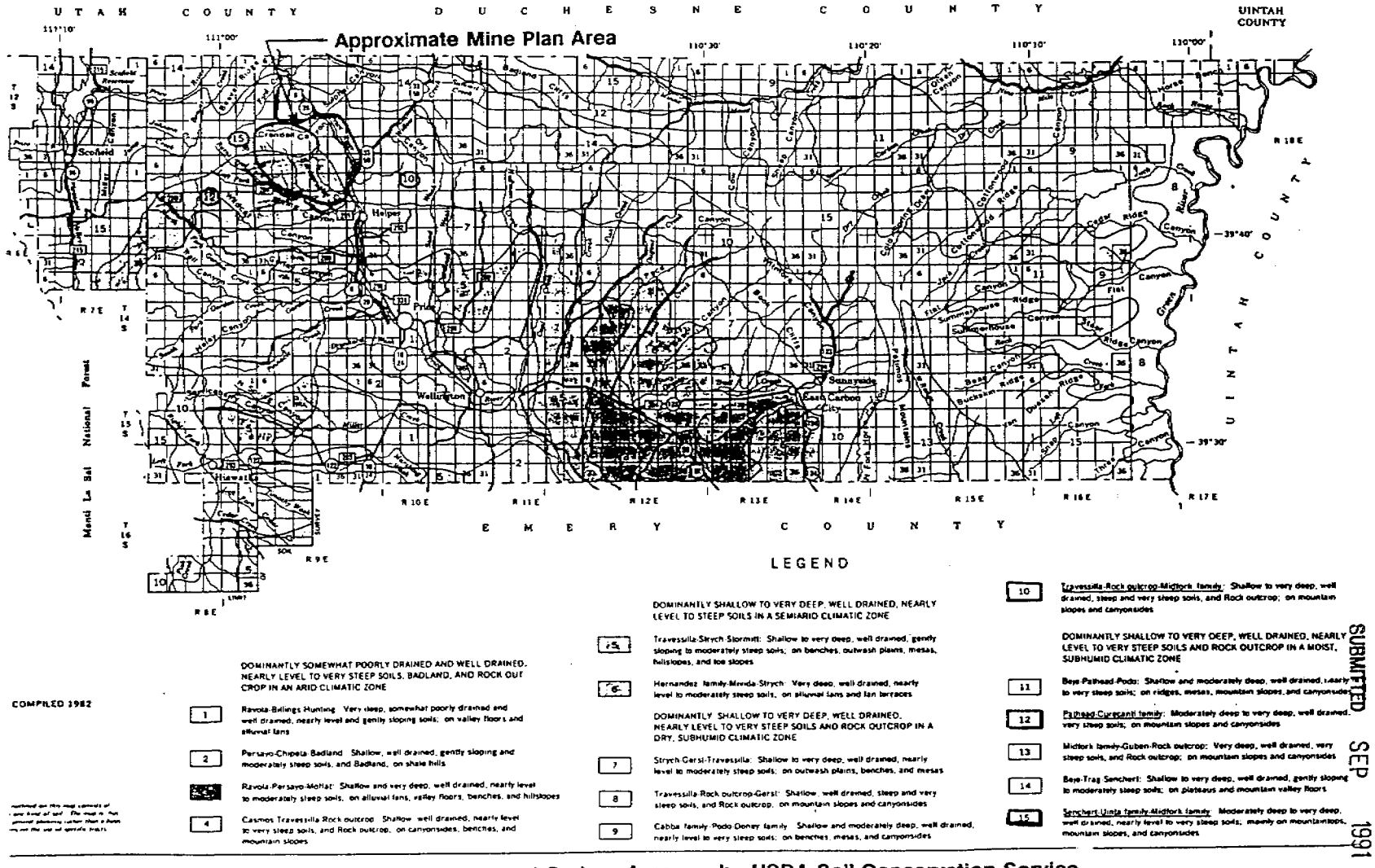
Description of Material

Coal Refuse: Deposited at location during operation of Diamanti coal tipple (1950 - 1975) - coal fines, rock fines, rock boulders
Rock is from No. 5 Mine - Texture: sand - sandy

Rock Waste: Deposited during 1978 - 1979 by Braztah Corporation from No. 3 Mine floor for purpose of refuse covering material - Texture: sand

	MATERIAL: COAL REFUSE					MATERIAL: ROCK WASTE	
Sample Dates =	1-25-80	6-2-82	4-25-83 #5 Roof	4-25-83 #5 Floor	2-29-84	4-25-83 #3 Mine Floor	2-29-84
AS	0.011	--	0.001	0.001	--	0.001	--
Se	0.002	--	0.003	0.003	--	0.003	--
Hg	0.04	--	0.0002	0.0002	--	0.001	--
Cd	0.004	--	0.005	0.005	--	0.005	--
Pd	0.06	--	0.05	0.05	--	0.05	--
Cr	0.01	--	0.005	0.005	--	0.005	--
Ag	0.01	--	0.004	0.004	--	0.004	--
Ba	0.8	--	0.27	0.25	--	0.16	--
K	--	0.22	--	--	--	--	--
Na	--	0.34	5.5	1.9	--	42	--
Ca	--	37.0	80	7.1	--	22	--
Mg	--	2.18	5.5	1.9	--	9.8	--
B	--	200.4	--	--	--	--	--
CL	--	0.15	--	--	--	--	--
SO_4	--	1.35	--	--	--	--	--
HCO_3	--	0.11	--	--	--	--	--
%K	--	0.22	--	--	--	--	--
NO_3-N	--	0.85	--	--	--	--	--
P	--	4.1	--	--	--	--	--
Organic Matter %	--	5.4	--	--	--	--	--
pH	--	8.45	--	--	7.7	--	--
EC	--	29.5	--	--	--	--	--
SAR	--	0.24	0.96	2.4	3.85	1.87	1.67
S-Tot	--	--	0.11	0.07	0.18	0.07	0.31
ALK	--	--	193	35	101	28	55
Salinity	--	--	408 (Mg/L)	510 (Mg/L)	0.05 (%)	281 (Mg/L)	0.20 (%)
Acid	0	--	--	--	0	--	--
Spec.Cond.	--	--	637	--	820	439	3,200

Figure 8-1 General Soils Map, Carbon County Area, Utah



Source: Soil Survey of Carbon Area, h, USDA Soil Concervation Service

SUBMITTED SEP 1991

SUBMITTED SEP 1991

Figure 8-2 SCS APPROVAL LETTER FOR SOIL MAPS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
350 NORTH 400 EAST
PRICE, UTAH 84501

June 6, 1991

David S. Ralston, PhD. CP Ag/SS
Castle Gate Coal Company
One Riverfront Place
20 N.W. First Street
Evansville, Indiana 47708

I have reviewed the soils maps and the write up for the Castle Gate Coal Company's permit that you sent me. This was made from our field work, the soil survey of the Carbon Caounty Utah and previous work submitted for earlier permits. After reviewing the maps, the map of Hardscrabble Canyon was correct after I added a line to separate soils map units 121 and 72 on the south side of the photo (shown in red). The Sowbelly Gulch Area map is correct as sent. The Crandle Canyon Area is correct with the adjustment of the location of the Commodore and Midfork soil names in unit 62 to show the location of these soils in the unit as we found them. Also by a Midfork name in the other 62 unit along the south side of the map (all adjustments shown in red). The Castle Gate Area with the preparation plant facilities is correct with the addition of a line in the north center part of the photo separating Colluvium and Strych soils from soils map unit (47) Guben and Rock outcrop (shown in red).

With these minor changes the order 1 soil survey of the areas mentioned will be correct.

The written material was found to be accurate with only a couple of minor changes (noted in red) and with the addition of Rock outcrop in unit 71. This is a major component in the area mapped 71 in Crandle Canyon, and listed as an inclusion in this unit.

Leland Sasser
Leland Sasser
Soil Scientist

Enclosures

FIGURE 8-3 SCS PRIME FARMLAND NEGATIVE DETERMINATION LETTER

United States Department of Agriculture
Soil Conservation Service

P.O. Box 11350
Salt Lake City, Utah 84147

SUBMITTED SEP 1991

May 21, 1991

Castle Gate Coal Company
One Riverfront Place
20 NW First Street
Evansville, Indiana 47708

Dear Sir:

In response to your letter we have made a review of the project area for Important Farmlands as requested. The project area as referenced is in Sections 28, 29, 26, 27, 22, 35 & 36, T.12S., R.9E. and Sections 1,3,4, 9 & 10, T. 13 S., R.9.E. Carbon County, Utah.

Because of rock excessive fragments and erodibility, the soils of this project area are eliminated from any category of Important Farmlands. Also, there is no reliable source of irrigation water available to the area.

We are retaining the documentation concerning this review for future reference. Should you have additional questions please call on us.

Sincerely,

Ferris P. Allgood
State Soil Scientist

cc:
Jan Anderson, DC, SCS, Price, Utah

The Soil Conservation Service is an agency of the Department of Agriculture

APPENDIX 8-1

EXCERPTS FROM S.C.S. SOIL SURVEY

APPENDIX A - EXCERPTS FROM SCS SOIL SURVEY OF CARBON AREA, UTAH

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit is given under "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Persayo loam, 3 to 8 percent slopes, is one of several phases in the Persayo series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes and associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Beje-Trag complex is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or

miscellaneous areas are somewhat similar. Midfork family-Podo association is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 3 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

20—Comodore-Datino Variant complex. This map unit is on mountain slopes and toe slopes in the Book Cliffs, northeast of Price. Slopes are 40 to 60 percent. Elevation is 6,800 to 8,100 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 50 percent Comodore very stony fine sandy loam, moist, 50 to 60 percent slopes; 35 percent Datino Variant extremely stony fine sandy loam, 40 to 60 percent slopes; and 15 percent other soils. About 15 percent of the unit has slopes of 40 to 50 percent. The Comodore soil is on side slopes, and the Datino Variant soil is on toe slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent Perma soils that have slopes of 15 to 40 percent, 5 percent Toze family soils that have slopes of 60 to 90 percent, small areas of soils that are similar to this Datino Variant soil but are 20 to 40 inches thick, and small areas of Rock outcrop.

The Comodore soil is shallow and well drained. It formed in colluvium derived dominantly from sandstone and shale. Slopes have northwest and east aspects, are 300 to 400 feet long, and are convex. The present vegetation is mainly Douglas-fir, Salina wildrye, snowberry, serviceberry, and mountain big sagebrush.

Typically, the surface layer is dark grayish brown very stony fine sandy loam about 6 inches thick. The underlying material to a depth of 14 inches is very dark grayish brown very stony loam over sandstone. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Comodore soil is moderate. Available water capacity is about 1 to 2 inches. Water supplying capacity is 3 to 6 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

The Datino Variant soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. Slopes are 300 to 400 feet long, are convex, and have east and west aspects. The present vegetation is mainly Douglas-fir, pinyon, Salina wildrye, bluebunch wheatgrass, snowberry, and serviceberry.

Typically, the surface layer is brown extremely stony fine sandy loam about 9 inches thick. The subsoil is brown very stony loam about 7 inches thick. The substratum to a depth of 60 inches or more is pale brown very stony fine sandy loam. A layer of calcium carbonate accumulation is at a depth of about 16 inches.

Permeability of the Datino Variant soil is moderate. Available water capacity is about 4 to 6 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as wildlife habitat and woodland.

The potential vegetation on the Comodore and Datino Variant soils includes an overstory of Rocky Mountain Douglas-fir and pinyon with a canopy of 50 percent. The understory vegetation is 40 percent grasses, 15 percent forbs, and 45 percent shrubs. Among the important plants are Salina wildrye, slender wheatgrass, birchleaf mountainmahogany, and snowberry.

This unit is limited for harvesting wood products because of the steepness of slope, stones and boulders on the surface, and the areas of Rock outcrop.

This unit is not grazeable by livestock because of the steepness of slope.

This unit is in capability subclass VIIe, nonirrigated, and in the Mountain Very Steep Stony Loam (Douglas-fir) woodland site.

24—Datino Variant very stony loam, 50 to 80 percent slopes. This very deep, well drained soil is on mountain slopes. It is near the upper end of Three Canyon, Trail Canyon, and Whitmore Canyon. It formed in colluvium derived dominantly from sandstone and shale. Slopes are 300 to 400 feet long and are slightly convex. The present vegetation is mainly Gambel oak, serviceberry, and birchleaf mountainmahogany. Elevation is 6,800 to 8,700 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is grayish brown very cobbly loam about 10 inches thick. The upper 8 inches of the substratum is pale brown very cobbly loam, and the lower part to a depth of 60 inches or more is pale brown very stony fine sandy loam. A layer of calcium carbonate accumulation is at a depth of about 16 inches.

Included in this unit are about 10 percent Perma soils that have slopes of 60 to 80 percent. Areas of this soil are intermingled with areas of the Datino Variant soil.

Permeability of this Datino Variant soil is moderate. Available water capacity is about 4.0 to 6.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for wildlife habitat.

The potential plant community on the Datino Variant soil is 35 percent grasses, 10 percent forbs, and 55 percent shrubs. Among the important plants are Columbia needlegrass, mountain brome, Gambel oak, snowberry, and Utah serviceberry.

This unit is not grazeable by livestock because of the steepness of slope.

The potential plant community on the Datino Variant soil is 35 percent grasses, 10 percent forbs, and 55 percent shrubs. Among the important plants are Gambel oak, snowberry, serviceberry, and bluegrass.

This unit is not grazeable by livestock because of the steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated, and in the Mountain Very Steep Loam (Oak) range site.

26—Doney family, 50 to 70 percent slopes. This moderately deep, well drained soil is on mountain slopes. It is in the vicinity of Bruin Point and Price Canyon. It formed in residuum and colluvium derived dominantly from siltstone and shale. Slopes are 100 to 300 feet long, are slightly concave, and dominantly have south and west aspects. The present vegetation is mainly Salina wildrye, bluebunch wheatgrass, mountain big sagebrush, snowberry, and lupine. Elevation is 8,100 to 9,500 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 70 to 100 days.

Typically, the surface layer is brown stony loam about 4 inches thick. The subsoil is pale brown loam 11 inches thick. The substratum to a depth of 35 inches is light gray loam over shale. Depth to weathered shale ranges from 20 to 40 inches.

Included in this unit are about 10 percent Pathead extremely stony loam on side slopes, 5 percent Rottulee family loam in drainageways, and small areas of a Midfork family soil that has slopes of 50 to 70 percent and has north and east aspects, Rock outcrop that occurs as ledges, and Curecanti family soil in the Price Canyon area.

Permeability of the Doney family soil is moderate. Available water capacity is about 4.5 to 6.0 inches. Water supplying capacity is 7 to 11 inches. Effective rooting depth is 20 to 40 inches. The organic matter content of the surface layer is 1 to 3 percent. Runoff is rapid, and the hazard of water erosion is moderate.

This unit is used as wildlife habitat and rangeland.

The potential plant community on the Doney family soil is 60 percent grasses, 15 percent forbs, and 25 percent shrubs. Among the important plants are Salina wildrye, prairie junegrass, bluegrass, and snowberry.

This unit is not grazeable by livestock because of the steepness of slope and the hazard of erosion.

This map unit is in capability subclass VIIe, nonirrigated, and in the Mountain Very Steep Loam (Saline Wildrye) range site.

47—Guben-Rock outcrop complex. This map unit is on mountain slopes. It is in the Book Cliffs, north of Helper and west of the Green River. Slopes are 50 to 80 percent, 100 to 200 feet long, and plane to convex. The present vegetation is mainly Douglas-fir, serviceberry, birchleaf mountainmahogany, mockorange, and western wheatgrass. Elevation ranges from 5,000 to 9,500 feet but is dominantly 6,000 to 7,500 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 55 percent Guben extremely bouldery fine sandy loam, 50 to 80 percent slopes; 20 percent Rock outcrop, and 25 percent other soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 12 percent Midfork family soils in concave areas and 10 percent Comodore very stony fine sandy loam, moist, intermingled throughout the unit. Also included are small areas of Perma family soils that have slopes of 60 to 80 percent.

The Guben soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of partially decomposed needles, twigs, and leaves about 0.5 inch thick. The surface layer is brown extremely bouldery fine sandy loam about 7 inches thick. The subsoil is brown very stony loam about 17 inches thick. The substratum to a depth of 60 inches or more is light brown very stony loam.

Permeability of the Guben soil is moderate. Available water capacity is about 3.5 to 5.0 inches. Water supplying capacity is 8.5 to 12.0 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is moderate, and the hazard of water erosion is slight.

Rock outcrop consists of areas of exposed bedrock, dominantly interbedded sandstone and shale. It occurs as ledges.

This unit is used as rangeland, wildlife habitat, woodland, and recreation areas.

The potential vegetation on the Guben soil includes an overstory of Rocky Mountain Douglas-fir and pinyon with a canopy of 50 percent. The understory vegetation is 40 percent grasses, 15 percent forbs, and 45 percent shrubs. Among the important plants are Salina wildrye, wheatgrass, birchleaf mountainmahogany, and snowberry.

This unit is severely limited for harvesting wood products because of the steepness of slope, the hazard of erosion, and stones and boulders on the surface.

This unit is not grazeable by livestock because of the steepness of slope.

The Guben soil is in capability subclass VIIe, nonirrigated, and in the Mountain Very Steep Stony Loam (Douglas-fir) woodland site. Rock outcrop is in capability subclass VIIIs. It is not placed in a woodland site.

62—Midfork family-Comodore complex. This map unit is on mountain slopes. It is along the Book Cliffs and Whitmore and Price Canyons. Slopes are 200 to 300 feet long and are convex. The present vegetation is mainly Douglas-fir, snowberry, and quaking aspen. Elevation is 7,900 to 9,500 feet.

This unit is 50 percent Midfork family bouldery loam, 50 to 70 percent slopes; 20 percent Comodore bouldery loam, 50 to 70 percent slopes; and 30 percent other soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 15 percent soils that are similar to the Midfork family soil but have a dark-colored surface layer less than 6 inches thick; 10 percent soils that are similar to the Midfork family soil but have a thick surface layer and a layer of calcium carbonate accumulation; and 5 percent Comodore very stony fine sandy loam, moist.

The Midfork family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 34 to 38 degrees F, and the average freeze-free period is 40 to 60 days.

Typically, the surface is covered with a mat of partially decomposed twigs, leaves, and needles about 2 inches thick. The surface layer is brown bouldery loam about 7 inches thick. The next layer is yellowish brown very channery loam 10 inches thick. Below this to a depth of 60 inches or more is yellowish brown very gravelly loam.

Permeability of the Midfork family soil is moderate. Available water capacity is about 5.5 to 7.0 inches. Water supplying capacity is 10 to 17 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is rapid, and the hazard of water erosion is high.

The Comodore soil is shallow and well drained. It formed in colluvium derived dominantly from sandstone, siltstone, and shale. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 80 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown bouldery loam about 6 inches thick. The underlying material to a depth of 19 inches is brown very stony loam over sandstone. Depth to sandstone ranges from 10 to 20 inches.

This unit is used for wildlife habitat and woodland.

The potential vegetation on this unit includes an overstory of Douglas-fir with a canopy of 90 percent. The understory vegetation is 10 percent grasses, 5 percent forbs, and 85 percent shrubs. Among the important plants are sedge, mountainlover, and snowberry.

The site index for Douglas-fir is 50. Average yield is about 27,200 board feet per acre for 100-year-old trees 12 inches in diameter or more.

This unit is severely limited for the harvesting of wood products because of the steepness of slope and the hazard of erosion.

This map unit is in capability subclass VIIe, nonirrigated, and in the High Mountain Very Steep Loam (Douglas-fir) woodland site.

71—Pathead extremely bouldery fine sandy loam, 40 to 70 percent slopes. This moderately deep, well drained soil is on mountain slopes and canyonsides. It is in the areas of Range Creek, Rock Creek, Whitmore Canyon, and Price Canyon. It formed in colluvium derived dominantly from sandstone and shale. Slopes are 100 to 200 feet long and have south aspects. The present vegetation in most areas is mainly curlleaf mountainmahogany, pinyon, juniper, Salina wildrye, and serviceberry. Elevation is 7,500 to 9,000 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

Typically, the surface layer is pale brown extremely bouldery fine sandy loam about 4 inches thick. The underlying material to a depth of 38 inches is pale brown and very pale brown very stony fine sandy loam. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are about 15 percent Perma soils that have slopes of 60 to 80 percent; 10 percent Comodore soils; and small areas of Senchert loam and Rock outcrop. The soils are in concave areas.

Permeability of this Pathead soil is moderate. Available water capacity is about 1.5 to 3.0 inches. Water supplying capacity is 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. The organic matter content of the surface layer is 1 to 3. Runoff is rapid, and the hazard of water erosion is moderate.

This unit is used as rangeland, wildlife habitat, and recreation areas.

The potential plant community on the Pathead soil is [illegible] percent grasses, 15 percent forbs, and 50 percent shrubs. Among the important plants are curlleaf mountainmahogany, Salina wildrye, and snowberry.

This unit is not grazeable by livestock because of the steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated, and in the Mountain Very Steep Stony Loam (Curlleaf Mountainmahogany) range site.

72—Pathead-Curecanti family association. This map unit is on mountain slopes. It is in the Spring Canyon and Gordon Creek areas, west of Helper. Slopes are 50 to 70 percent, 300 to 400 feet long, and convex. Elevation is 6,800 to 9,000 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 40 percent Pathead extremely stony loam, 50 to 70 percent slopes; 30 percent Curecanti family loam, 50 to 70 percent slopes; and 30 percent other soils and miscellaneous areas. The Pathead soil is on ridges and shoulders, and the Curecanti family soil generally has north aspects and is in drainageways.

Included in this unit are about 8 percent Podo cobbly loam, 7 percent Midfork family soils, and small areas of Pathead extremely bouldery fine sandy loam, Podo very bouldery sandy loam, Senchert loam, and Rock outcrop.

The Pathead soil is moderately deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The present vegetation is mainly Salina wildrye, low gray sage, and winterfat. Typically, the surface layer is brown extremely stony loam about 3 inches thick. The underlying material is pale brown very cobbly loam to a depth of 26 inches. Sandstone is at a depth of 20 to 40 inches.

Permeability of the Pathead soil is moderate. Available water capacity is about 1 to 2 inches. Water supplying capacity is 3.5 to 6.5 inches. Effective rooting depth is 20 to 40 inches. The organic matter content of the surface layer is 1 to 3 percent. Runoff is rapid, and the hazard of water erosion is high.

The Curecanti family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The present vegetation is mainly Gambel oak, snowberry, Kentucky bluegrass, and aspen peavine. Typically, the upper part of the surface layer is dark grayish brown loam about 7 inches thick and the lower part is brown very stony loam about 8 inches thick. The subsurface layer is very pale brown very stony loam about 5 inches thick. The subsoil to a depth of 60 inches or more is pale brown very stony loam.

Permeability of the Curecanti family soil is moderate. Available water capacity is about 5.0 to 6.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as wildlife habitat and rangeland.

The potential plant community on the Pathead soil is 60 percent grasses, 15 percent forbs, and 25 percent shrubs. Among the important plants are Salina wildrye, prairie junegrass, bluegrass, and snowberry.

This soil is not grazeable by livestock because of the steepness of slope and the hazard of erosion.

The potential plant community on the Curecanti family soil is 35 percent grasses, 10 percent forbs, and 55 percent shrubs. Among the important plants are Gambel oak, snowberry, serviceberry, and bluegrass.

This soil is not grazeable by livestock because of the steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated. The Pathead soil in the Mountain Very Steep Loam (Saline Wildrye) range site, and the Curecanti family soil is in the Mountain Very Steep Loam (Oak) range site.

107—Shupert-Winetti complex. This map unit is on narrow valley and canyon floors in the Book Cliffs and in an area northwest of Price and east of Sunnyside. Slopes are 1 to 8 percent, 100 to 200 feet long, and concave. The present vegetation in most areas is mainly basin big sagebrush, rabbitbrush, cheatgrass, needleandthread, and dropseed. Elevation ranges from 4,600 to 7,200 feet but commonly is 5,200 to 6,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 43 to 45 degrees F, and the average freeze-free period is 80 to 100 days.

This unit is 40 percent Shupert gravelly loam, 1 to 8 percent slopes; 35 percent Winetti bouldery sandy loam, 1 to 8 percent slopes; and 25 percent other soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 15 percent Haverdad loam on toe slopes, 5 percent Glenberg family very fine sandy loam on toe slopes at lower elevations, and 5 percent soils that are similar to the Winetti soil but are along the stream channels and support riparian vegetation.

The Shupert soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is pale brown gravelly loam about 3 inches thick. The next layer is pale brown clay loam about 6 inches thick. Below this to a depth of 60 inches or more is light brownish gray and light yellowish brown clay loam.

Permeability of the Shupert soil is moderately slow. Available water capacity is about 10.0 to 11.5 inches. Water supplying capacity is 6.5 to 10.0 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 1 to 2 percent. Runoff is slow, and the hazard of water erosion is moderate. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

The Winetti soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown bouldery sandy loam about 6 inches thick. The next layer is pale brown loam about 5 inches thick. The next layer is pale brown and brown very bouldery loam about 23 inches thick. Below this to a depth of 60 inches or more is pale brown very gravelly sandy loam.

Permeability of the Winetti soil is moderately rapid. Available water capacity is about 4.0 to 5.5 inches. Water supplying capacity is 4.5 to 8.0 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 1 to 3 percent. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

This unit is used mainly as rangeland and wildlife habitat. It is also used for irrigated crops.

The potential plant community on the Shupert and Winetti soils is 60 percent grasses, 10 percent forbs, and 30 percent shrubs. Important plants are basin wildrye, western wheatgrass, basin big sagebrush, and rubber rabbitbrush.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. If the desirable forage plants are mostly depleted, brush management and rangeland seeding can be used to improve the rangeland vegetation. Suitable brush management practices include prescribed burning, chemical spraying, and mechanical treatment.

The suitability of this unit for rangeland seeding is good. Plants suitable for seeding include adapted native plants and Russian wildrye, crested wheatgrass, and ladak alfalfa.

This map unit is in capability unit IIIe-3, irrigated, and in capability subclass VIIe, nonirrigated. It is in the Loamy Bottom range site.

121—Travessilla-Rock outcrop-Gerst complex. This map unit is on canyonsides in the area of Jack Creek and along the Book Cliffs, extending from Price Canyon to Sunnyside. Slopes are 40 to 70 percent. Elevation ranges from 5,000 to 8,100 feet but dominantly is 6,000 to 7,500 feet.

This unit is 40 percent Travessilla extremely bouldery loam, 40 to 70 percent slopes; 30 percent Rock outcrop; 20 percent Gerst very channery loam, dry, 50 to 70 percent slopes; and 10 percent other soils. About 25 percent of the Travessilla soil has slopes of 40 to 50 percent. The Travessilla soil is on north and west aspects at the higher elevations. Rock outcrop is on canyon rims and ledges. The Gerst soil is on south and west aspects at the lower elevations. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent Travessilla sandy loam on benches and 5 percent Guben extremely bouldery loam on canyonsides.

The Travessilla soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from sandstone and shale. Slopes are 100 to 200 feet long, are concave to convex, and have north and east aspects. The present vegetation in most areas is mainly pinyon, juniper, Douglas-fir, Salina wildrye, and birchleaf mountainmahogany. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 45 to 47 degrees F, and the average freeze-free period is 80 to 120 days. Typically, the surface layer is pale brown extremely bouldery loam about 2 inches thick. The underlying material to a depth of 12 inches is pale brown very fine sandy loam over sandstone. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Travessilla soil is moderately rapid. Available water capacity is about 1 to 2 inches. Water supplying capacity is 3 to 4 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 1 to 2 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed sandstone and siltstone.

The Gerst soil is shallow and well drained. It formed in residuum derived dominantly from shale. Slopes are 100 to 200 feet long, are concave to convex, and have south and west aspects. The present vegetation in most areas is mainly juniper, pinyon, Salina wildrye, and Mormon-tea. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 47 to 49 degrees F, and the average freeze-free period is 110 to 135 days. Typically, the surface layer is light brownish gray very channery loam about 5 inches thick. The underlying material to a depth of 19 inches is light brownish gray channery loam over weathered shale. Weathered shale is at a depth of 10 to 20 inches.

Permeability of the Gerst soil is moderately slow. Available water capacity is about 1.5 to 3.0 inches. Water supplying capacity is 2 to 3 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 0.5 to 1.0 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland, woodland, and wildlife habitat.

The potential vegetation on the Travessilla soil includes an overstory of pinyon, Utah juniper, and Douglas-fir with a canopy of 30 percent. The understory vegetation is 10 percent grasses, 15 percent forbs, and 75 percent shrubs. Among the important plants are birchleaf mountainmahogany, Utah serviceberry, bluegrass, and Salina wildrye.

The site index for pinyon and Utah juniper is 37. Average yield is 6 cords of wood per acre. The potential for the production of posts or Christmas trees is very poor. This unit is severely limited for the harvesting of wood products because of the steepness of slope and the hazard of erosion.

This soil is not grazeable by livestock because of the steepness of slope and the stony surface layer.

The potential vegetation on the Gerst soil includes an overstory of Utah juniper and pinyon with a canopy of 5 to 20 percent. The understory vegetation is 10 percent grasses, 10 percent forbs, and 80 percent shrubs. Among the important plants are galleta, Salina wildrye, and shadscale.

The site index for Utah juniper and pinyon is 15 to 20. Average yield is 1 to 2 cords of wood per acre. The potential for the production of posts or Christmas trees is poor. Limitations for the harvesting of wood products are severe because of the steepness of slope and the hazard of erosion.

The suitability of this soil for grazing is very poor. The main limitations are steepness of slope and the hazard of erosion.

This map unit is in capability subclass VIIe, nonirrigated. The Travessilla soil is in the Upland Very Steep Shallow Loam (Pinyon-Utah Juniper) woodland site. The Gerst soil is in the Semidesert Very Steep Shallow Clay (Utah Juniper) woodland site. The Rock outcrop is not placed in a woodland site.

125—Uinta-Toze families complex. This map unit is on mountain slopes. It is in the Bruin Point area and on the eastern side of Patmos Head. Slopes are 30 to 75 percent, 300 to 400 feet long, and plane to convex. The present vegetation is mainly subalpine fir, aspen, and Douglas-fir. Elevation is 7,800 to 9,600 feet. The average annual precipitation is about 20 to 30 inches, the average annual air temperature is 34 to 38 degrees F, and the average freeze-free period is 40 to 60 days.

This unit is 35 percent Uinta family loam, 40 to 70 percent slopes; 30 percent Toze family fine sandy loam, 35 to 70 percent slopes; and 35 percent other soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 15 percent soils that are similar to the Uinta family soil but do not have a bleached layer below the surface layer, 15 percent Comodore bouldery loam, and 5 percent Midfork family bouldery loam.

The Uinta family soil is deep and well drained. It formed in colluvium derived dominantly from sandstone and siltstone. About 30 percent of the acreage of this soil has slopes of 40 to 50 percent. Typically, the surface is covered with a mat of leaves, twigs, and needles 1 inch thick. The surface layer is dark grayish brown loam about 3 inches thick. The subsurface layer is light yellowish brown stony sandy loam about 8 inches thick. The subsoil is pale brown and light brownish gray stony clay loam about 31 inches thick. Sandstone is at a depth of 42 inches. Depth to sandstone or siltstone ranges from 40 to 60 inches or more.

Permeability of the Uinta family soil is moderately slow. Available water capacity is about 6.0 to 7.5 inches. Water supplying capacity is 9 to 16 inches. Effective rooting depth is 40 to 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is rapid, and the hazard of water erosion is high.

The Toze family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone, siltstone, and shale. About 40 percent of the acreage of this soil has slopes of 35 to 50 percent. Typically, the surface is covered with mat of leaves, twigs, and needles about 1 inch thick. The upper 3 inches of the surface layer is dark grayish brown fine sandy loam, and the lower part is dark grayish brown loam and gravelly silt loam 21 inches thick. The next layer is grayish brown gravelly silt loam about 8 inches thick. Below this to a depth of 60 inches or more is pale brown very gravelly fine sandy loam. A layer of calcium carbonate accumulation is at a depth of about 24 inches.

Permeability of the Toze family soil is moderate. Available water capacity is about 6 to 9 inches. Water supplying capacity is 11 to 18 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is rapid, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for wildlife habitat and woodland.

The potential vegetation on the soils in this unit includes an overstory of Engelmann spruce and subalpine fir with a canopy of 80 percent. The understory vegetation is 20 percent grasses, 5 percent forbs, and 75 percent shrubs. Among the important plants are blueberry, Oregon-grape, sedges, pinegrass, and currant.

This unit is well suited to the production of Engelmann spruce and subalpine fir. The site index for Engelmann spruce is 55, and the site index for subalpine fir is 60. This unit is severely limited for the harvesting of wood products because of the steepness of slope and the hazard of erosion.

Trees that are suitable for planting are Engelmann spruce and subalpine fir.

This unit is not grazeable by livestock because of the steepness of slope and low forage production.

This map unit is in capability subclass VIIe, nonirrigated, and in the High Mountain Very Steep Stony Loam (Engelmann Spruce) woodland site.

126—Winetti Variant cobbly fine sandy loam, 0 to 8 percent slopes. This very deep, well drained soil is on alluvial fans along the Green River. It formed in alluvium derived dominantly from sedimentary rock. Slopes are 300 to 400 feet long and are plane to slightly convex. The present vegetation is mainly greasewood, cheatgrass, big sagebrush, and alkali sacaton. Elevation is 4,300 to 5,200 feet. The average annual precipitation is about 8 to 10 inches, the average annual air temperature is 47 to 49 degrees F, and the average freeze-free period is 110 to 135 days.

Typically, the surface layer is pale brown cobbly fine sandy loam about 3 inches thick. The upper 15 inches of the underlying material is pale brown sand, sandy loam, and fine sandy loam, the next 35 inches is pale brown extremely gravelly sand, and the lower part to a depth of 60 inches or more is pale brown fine sandy loam.

Included in this unit are about 10 percent Green River silt loam on streambanks and 5 percent Glenberg family very fine sandy loam on streambanks.

Permeability of this Winetti Variant soil is moderately rapid. Available water capacity is about 2 to 3.5 inches. Water supplying capacity is 2 to 4 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 1 to 3 percent. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Winetti soil is 60 percent grasses, 10 percent forbs, and 30 percent shrubs. Among the important plants are basin wildrye, western wheatgrass, basin big sagebrush, and rubber rabbitbrush.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. If the desirable forage plants are mostly depleted, brush management and rangeland seeding can be used to improve the rangeland vegetation. Suitable brush management practices include prescribed burning, chemical spraying, and mechanical treatment.

The suitability of this unit for rangeland seeding is good. Plants suitable for seeding include adapted native plants and Russian wildrye, crested wheatgrass, and ladak alfalfa.

This map unit is in capability subclass VIIs, nonirrigated, and in the Loamy Bottom range site.

APPENDIX 8-2

SOIL TESTING RESULTS AND LETTERS CERTIFICATIONS

STATE OF UTAH
NATURAL RESOURCES & ENERGY
Oil, Gas & Mining

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Cleon B. Feight, Division Director

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

June 7, 1982

Mr. Robert L. Wiley
Environmental Engineer
Price River Coal Company
P.O. Box 629
Helper, Utah 84526

RE: Modification to use existing gravel pit for resoiling materials storage
PRCC
ACT/007/004
Carbon County, Utah

Dear Rob:

The Division has reviewed the request for a minor modification to the mine plan to make use of an existing on-site gravel pit for "topsoiling and other soiling materials" storage. The plan appears not only logical but justified in nature and although appearances initially conjure up the old parable involving Peter and Paul, I'm sure that long-term solutions will eventually be developed.

It is our understanding that this area is on fee land; has been previously disturbed by a gravel operation; and is already an existing part of the mine plan area. In delivering final approval for this project there are a few thoughts the Division would like confirmed. At your earliest opportunity could you provide answers to the following:

In reference to the final reclamation; which reference area (RA) will be used for revegetation success? Please provide confirmation of your intentions to commit to the type of reclamation methodology used in the Crandall Canyon project proposal.

A 1:1 slope could pose a highly erosive situation if the ditch is unlined as the flow is assumed to enter in a diffuse manner. The DOGM suggests that PRCC rip-rip the sides of the channel to prevent such an occurrence.

The Division's approval is hereby given for this modification in the knowledge that contractual deadlines may be met by its implementation. Please address the earlier mentioned concerns in light of this decision.

Enclosed is a copy of the DWR letter discussed on June 1, 1982.

Sincerely yours,

THOMAS N. TEITING
ENGINEERING GEOLOGIST

Encl: a/s

cc: OSM, John Montgomery

TNT/cp

Soil Tests Results

(From Crandall Canyon Development

	Sample No. 1	Site
2/25/81	1	Shaft Site
4/9/81	1	No. 1 Topsoil Pile
5/8/81	2	Topsoil - Yarding Area
	3	Topsoil - Yarding Area
	4	Sub-Soil - Yarding Area
	5	Sub-soil - Yarding Area
10/12/81	2A	Topsoil - Upper Site
	2B	Sub-Soil - Upper Site
	2C	Sub-Soil - Upper Site
	4A	Topsoil - Upper Site
	4B	Sub-soil - Upper Site
	4C	Sub-soil - Upper Site
	6A	Topsoil - Upper Site
	6B	Sub-soil - Upper Site
	6C	Sub-Soil - Upper Site
	8A	Topsoil - Upper Site
	8B	Sub-soil - Upper Site
	LF-1	Topsoil - Leachfield Area
	BT-1	Buried Topsoil @ 24" Below Surface
	B-2	Buried Topsoil @ 60" Below Surface

Kirk Wilkey
"Eob"
Price River Coal Co.
472-3411

SOIL TESTING LABORATORY
Utah State University UMC 48
Logan, Utah 84322

SOIL TEST REPORT
and
FERTILIZER RECOMMENDATIONS

HORROCKS ENGINEERS
MAR 3 1981
RECEIVED

CRANDALL CYN.
TOPSOIC - SHAFTS

Date received 2/25/81

Payment received $5.00

Balance due $-0-

Name Horrocks Engineers

Street 1 West Main

City, State American Fork, Utah 84003
ZIP

Your USU Extension Agent Jay Hall

LABORATORY REPORT

Lab. No.	Sample No.	Crop	Soil Texture (Estimated)	Lime	pH	Soluble Salts EC_e	Organic Matter %	Plant Nutrient Index			
								Nitrate ppm N	Phosphorus ppm P	Potassium ppm K	
S-280	1	(*)	Sandy Loam	++	8.3	.2			1.8	95	

5 AC/

ATTENTION GROWERS

These fertilizer recommendations are based on the soil analysis results, the information you supplied on the Description sheet, and on the average growing season for your area. They are guides developed from the best available scientific data, but may require some modification for your specific situation. Consult your Extension Agent for more details.

Remember that a high yield goal can be attained only when proper fertilization is used in combination with crop production management and climatic conditions consistent with that yield goal.

USU POLICY

It is the policy of the USU Soil Testing Laboratory to recommend only those nutrients that offer a reasonable possibility of increasing the yield of your crops, and in those amounts that should be necessary to achieve your yield capability. Ranges of nutrients are sometimes given, to permit some farm operator judgement.

FERTILIZER RECOMMENDATIONS FOR 19 81 CF

Sample No.	Pounds of Nutrient per acre				S
	Nitrogen (N)	Phosphorus (as P_2O_5)	Potassium (as K_2O)	Other	
1	150	60–100	50–100		
	SEE ENCLOSED FERTILIZER GUIDE				

*See referenced notes on the back of this sheet for explanations and special instructions.

** Sorry, We have no specific information for crops indicated, however, your test results show nutrient level quite low for most crops. Fertilizer Recommendations were made considerating mostly the grasses.

Acre Ft. x 2004 lbs 150# Nitrogen

P_2O_5 x .45 = P

K_2O x .82 = K

SOIL TEST REPORT
and
FERTILIZER RECOMMENDATIONS

SOIL TESTING LABOR
Utah State University
Logan, Utah 84322

Name R.L. Wiler
Price River Coal Co.
Street P.O. Box 629
City, State Helper, Utah 84526
ZIP

Date received 4/9
Payment received $
Balance due $

Your USU Extension Agent Jay Hall

LABORATORY REPORT

Lab. No.	Sample No.	Crop	Soil Texture (Estimated)	Lime	pH	Soluble Salts EC_e	Organic Matter %	Plant Nutrient Index		
								Nitrate ppm N	Phosphorus ppm P	Potassium ppm K
S-667	1	Range	Sandy Loam	+	8.0	.3			6.6	157
					OK				↓	OK
							Probably OK for g			
							and native shrubs.			
							No data, so can't			
							specific.			

ATTENTION GROWERS

These fertilizer recommendations are based on the soil analysis results, the information you supplied on the Description sheet, and on the average growing season for your area. They are guides developed from the best available scientific data, but may require some modification for your specific situation. Consult your Extension Agent for more details.

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FERTILIZER RECOMMENDATIONS FOR 19__

Sample No.	Pounds of Nutrient per acre			
	Nitrogen (N)	Phosphorus (as P_2O_5)	Potassium (as K_2O)	Other
	*			
	* Amount depends			
	on area, climate, crop			

*See referenced notes on the back of this sheet for explanations and special instructions.

$P_2O_5 \times .45 = P$

$K_2O \times .82 = K$

SOIL TESTING LABORATORY
Utah State University UMC 48
Logan, Utah 84322

SOIL TEST REPORT
and
FERTILIZER RECOMMENDATIONS

Date received 5/8/81

Payment received $52.00

Balance due $-0-

Name Price River Coal Co.
c/o Robert L. Wiley
Street P.O. Box 629

City, State Helper, Utah 84526
ZIP

Your USU Extension Agent Jay Hall

LABORATORY REPORT

Lab. No.	Sample No.	Crop	Soil Texture (Estimated)	Lime	pH	Soluble Salts EC_e	Organic Matter %	Plant Nutrient Index			
								Nitrate ppm N	Phosphorus ppm P	Potassium ppm K	CEC meq/
S-874	2		Loam	+	7.7	.3		10.7	9.2	106	9.3
S-875	3		Loam	++	7.9	.4		.9	6.8	129	11.3
S-876	4		Loam	+	7.7	.3		7.5	13.	157	10.9
S 35	5		Loam	++	7.9	.4		6.1	15.	196	1

ATTENTION GROWERS

These fertilizer recommendations are based on the soil analysis results, the information you supplied on the Description sheet, and on the average growing season for your area. They are guides developed from the best available scientific data, but may require some modification for your specific situation. Consult your Extension Agent for more details.

Remember that a high yield goal can be attained only when proper fertilization is used in combination with crop production management and climatic conditions consistent with that yield goal.

USU POLICY

It is the policy of the USU Soil Testing Laboratory to recommend only those nutrients that offer a reasonable possibility of increasing the yield of your crops, and in those amounts that should be necessary to achieve your yield capability. Ranges of nutrients are sometimes given, to permit some farm operator judgement.

FERTILIZER RECOMMENDATIONS FOR 19__ C

Pounds of Nutrient per acre

Sample No.	Nitrogen (N)	Phosphorus (as P_2O_5)	Potassium (as K_2O)	Other

*See referenced notes on the back of this sheet for explanations and special instructions.

$P_2O_5 \times .45 = P$

$K_2O \times .82 = K$

SOIL, PLANT AND WATER ANALYSIS LABORATORY

Utah State University UMC 48
Logan, Utah 84322

R.L. Wiley

Collected by: C/O Price River Coal Company Date: 10/12/81

Address: Box 629

Helper, UT 84526

Collector's No.:	2A	2/B	2/C	4/A	4/B	4/C
USU Lab No.:	S-1513	1514	1515	1516	1517	1518

Standard Fertility Tests

pH	7.7	7.7	8.0	8.0	8.0	7.8
Salinity (EC_e) .mmhos/cm	.3	.3	.5	.3	.3	.3
Phosphorus .ppm	21.0	10.2	7.7	8.0	16.0	17.0
Potassium .ppm	279	195	144	172	118	120
Texture (estimated) .–	SiL	SiL	L	L	L	L
Lime (+ = present) .o, +, ++	+	+	++	++	++	++

Special Chemical Tests

Cation exchange capacity .me/100g						
Exchangeable sodium percent .%						
Exchangeable calcium percent .%						
Exchangeable____percent .%						
Extractable sodium .me/100g						
Extractable calcium .me/100g						
Extractable____ .me/100g						
Gypsum .%						
Lime - ($CaCO_3$ equiv.) .%						
Nitrogen (nitrate) .ppm	3.7	1.6	1.2	7.5	3.8	1.4
Nitrogen (total) .%						
Organic Carbon .%						
Water-soluble sodium .me/1						
Water-soluble____ .me/1						
Water-soluble____ .me/1						
Water-soluble____ .me/1						
Zinc .ppm						
Other chemical tests:						
_____ ____						
_____ ____						
_____ ____						

Special Physical Tests

Moisture (1/3 atm.) .%						
Moisture (15 atm.) .%						
Moisture (Saturation) .%						
Sand .%						
Silt .%						
Clay .%						
Classification .–						
Other physical tests:						
_____ ___						
_____ ___						

SOIL, PLANT AND WATER ANALYSIS LABORATORY

Utah State University UMC 48
Logan, Utah 84322

Collected by: Price River Coal Company Date: _____

Address: Page 2

Collector's No.:	6/A	6/B	6/C	8/A	8/B	8/C
USU Lab No.:	S-1519	1520	1521	1522	1523	1524
Standard Fertility Tests						
pH —	7.8	8.0	8.1	8.1	8.1	8.1
Salinity (EC_e) mmhos/cm	.2	.2	.2	.2	.3	.2
Phosphorus ppm	9.1	6.6	4.1	9.0	2.7	2.7
Potassium ppm	120	109	94	177	124	109
Texture (estimated) —	SL	SL	SL	SL	SL	SL
Lime (+ = present) o, +, ++	++	++	++	++	++	++
Special Chemical Tests						
Cation exchange capacity me/100g						
Exchangeable sodium percent %						
Exchangeable calcium percent %						
Exchangeable____percent %						
Extractable sodium me/100g						
Extractable calcium me/100g						
Extractable____ me/100g						
Gypsum %						
Lime - ($CaCO_3$ equiv.) %						
Nitrogen (nitrate) ppm	4.3	5	4	3.1	1.9	1.8
Nitrogen (total) %						
Organic Carbon %						
Water-soluble sodium me/1						
Water-soluble____ me/1						
Water-soluble____ me/1						
Water-soluble____ me/1						
Zinc ppm						
Other chemical tests:						
_____ ____						
_____ ____						
_____ ____						
Special Physical Tests						
Moisture (1/3 atm.) %						
Moisture (15 atm.) %						
Moisture (Saturation) %						
Sand %						
Silt %						
Clay %						
Classification —						
Other physical tests:						
_____ ____						
_____ ____						

SOIL, PLANT AND WATER ANALYSIS LABORATORY

Utah State University UMC 48
Logan, Utah 84322

Collected by: Price River Coal Company Date: _____

Address: Page 3

Collector's No.:	LF/1	BT/1	BT/2	GC/1	GC/2	
USU Lab No.:	S-1525	1526	1527	1528	1529	
Standard Fertility Tests						
pH	8.0	8.2	8.3	8.0	8.0	
Salinity (EC_e) .mmhos/cm	.3	.3	.3	3.2	.6	
Phosphorus .ppm	3.0	6.6	2.4	95	46	
Potassium .ppm	178	312	80	329	>400	
Texture (estimated)	L	L	L	L	SiL	
Lime (+ = present) .o, +, ++	++	—	++	++	++	
Special Chemical Tests						
Cation exchange capacity .me/100g						
Exchangeable sodium percent .%						
Exchangeable calcium percent .%						
Exchangeable____percent .%						
Extractable sodium .me/100g						
Extractable calcium .me/100g						
Extractable____ .me/100g						
Gypsum .%						
Lime - ($CaCO_3$ equiv.) .%						
Nitrogen (nitrate) .ppm	4.9	=	1.5	49	51	
Nitrogen (total) .%						
Organic Carbon .%						
Water-soluble sodium .me/1						
Water-soluble____ .me/1						
Water-soluble____ .me/1						
Water-soluble____ .me/1						
Zinc .ppm						
Other chemical tests:						
_____ ____						
_____ ____						
_____ ____						
Special Physical Tests						
Moisture (1/3 atm.) .%						
Moisture (15 atm.) .%						
Moisture (Saturation) .%						
Sand .%						
Silt .%						
Clay .%						
Classification .—						
Other physical tests:						
_____ ____						
_____ ____						

COMPARISON OF CHEMICAL ANALYSES OF COAL REFUSE AND ROCK WASTE IN HARDSCRABBLE CANYON AT GOOSE ISLAND

Description of Material

Coal Refuse: Deposited at location during operation of Diamanti coal tipple (1950 - 1975) - coal fines, rock fines, rock boulders
Rock is from No. 5 Mine - Texture: sand - sandy

Rock Waste: Deposited during 1978 - 1979 by Braztah Corporation from No. 3 Mine floor for purpose of refuse covering material - Texture: sand

	MATERIAL: COAL REFUSE					MATERIAL: ROCK WASTE	
Sample Dates =	1-25-80	6-2-82	4-25-83 #5 Roof	4-25-83 #5 Floor	2-29-84	4-25-83 #3 Mine Floor	2-29-84
AS	0.011	--	0.001	0.001	--	0.001	--
Se	0.002	--	0.003	0.003	--	0.003	--
Hg	0.04	--	0.0002	0.0002	--	0.001	--
Cd	0.004	--	0.005	0.005	--	0.005	--
Pd	0.06	--	0.05	0.05	--	0.05	--
Cr	0.01	--	0.005	0.005	--	0.005	--
Ag	0.01	--	0.004	0.004	--	0.004	--
Ba	0.8	--	0.27	0.25	--	0.16	--
K	--	0.22	--	--	--	--	--
Na	--	0.34	5.5	1.9	--	42	--
Ca	--	37.0	80	7.1	--	22	--
Mg	--	2.18	5.5	1.9	--	9.8	--
B	--	200.4	--	--	--	--	--
CL	--	0.15	--	--	--	--	--
SO_4	--	1.35	--	--	--	--	--
HCO_3	--	0.11	--	--	--	--	--
%K	--	0.22	--	--	--	--	--
NO_3-N	--	0.85	--	--	--	--	--
P	--	4.1	--	--	--	--	--
Organic Matter %	--	5.4	--	--	--	--	--
pH	--	8.45	--	--	7.7	--	--
EC	--	29.5	--	--	--	--	--
SAR	--	0.24	0.96	2.4	3.85	1.87	1.67
S-Tot	--	--	0.11	0.07	0.18	0.07	0.31
ALK	--	--	193	35	101	28	55
Salinity	--	--	408 (Mg/L)	510 (Mg/L)	0.05 (%)	281 (Mg/L)	0.20 (%)
Acid	0	--	--	--	0	--	--
Spec.Cond.	--	--	637	--	820	439	3,200

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-8350

IC L. TAYLOR, Ph.D.
MANAGER
INSTRUMENTAL ANALYSIS DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE TO
490 ORCHARD ST., GOLDEN, CO 80401
OFFICE TEL. (303) 278-9521

February 29, 1984

Jack Blair
C T & E
224 South Carbon Avenue
Price, UT 84501

PRICE RIVER COAL CO.

57-15012 #1 Coal Refuse, Goose Island

57-15013 #2 Rock Waste

Sampled 2-4-84

RE: IAD #97-N805-335-02

Analytical Report

Two soil samples were received for analysis on February 21, 1984. These samples were assigned our IAD identification #97-N805-335-02.

Textural Analysis was performed in accordance with the procedure of ASTM, Part 19, Method D422. The results of these determinations are presented in Table No. I and are reported in weight percent (Wt %) on an "as received" basis.

Alkalinity, Salinity, Specific Conductance, pH and Sodium Adsorption Ratio (SAR) were determined on the saturated paste extract in accordance with the procedures of Handbook No. 60, USDA, August, 1969. The results of these determinations are presented in Table No. II and are reported on the saturation extract basis in units as indicated in the table.

Table No. I
(Wt. % As Received)

Parameter	57-15012	57-15013
Gravel (75 to 4.75 mm)	0.0	0.0
Coarse Sand (4.75 to 2.00 mm)	30.6	18.8
Medium Sand (2.00 to 0.425 mm)	0.0	0.0
Fine Sand (0.425 to 0.074 mm)	62.6	71.3
Silt (0.074 to 0.005 mm)	5.2	8.0
Clay (<0.005 mm)	1.5	1.9
Texture	Sand	Sand

Table No. II
(Saturation Extract)

Parameter	57-15012	57-15013
Alkalinity as $CaCO_3$ (mg/L)	101	54.6
Salinity (%)	0.05	0.20
Specific Conductance at 25°C (μmhos/cm)	820	3,200
pH (Standard Units)	7.7	7.5
SAR (Ratio)	3.85	1.67
% Total Sulfur	0.18	0.31

If you have any questions concerning these results please call.

Harold A. Connell
Assistant Lab Manager

Robert L. Taylor, Ph.D., Mngr.
Instrumental Analysis Div.

as

SAMPLES BY NATIVE PLANTS INC. - 6-2-82

Sample

	pH	EC	SAR	K*	Na*	Ca*	Mg*	Cl*	SO_4*	HCO_3*
Topsoil	8.38	0.14	0.47	0.53	0.52	23.0	1.16	<.001	0.04	0.009
New refuse (School House)	7.89	1.76	3.62	0.44	4.26	26.4	1.23	0.31	1.6	0.014
New refuse	9.43	0.73								
Topsoil	8.99	0.11								
Old refuse										
0-15 cm	6.70	0.96								
15-30 cm	5.77	1.55								
#22										
0-15 cm	8.53	0.22	0.26	0.25	0.37	36.4	2.30	0.03	1.3	0.010
15-30 cm	8.38	0.37	0.22	0.19	0.31	37.9	2.06	<.001	1.48	0.012
#23										
0-30 cm	8.05	0.40								

	ppm B	%K	NO_3-N	P	% Organic Matter	% Sand	% Silt	% Clay	Texture
Topsoil	58.0	0.62	1.35	4.2	3.4	37	37	26	loam
New refuse (School House)	58.4	0.39				63	16	21	sandy clay loam
New refuse			0.90	2.0	6.3	63	17	20	sandy clay loam
Topsoil						35	32	33	clay loam
Old refuse									
0-15 cm						72	12	16	sandy loam
15-30 cm						70	12	18	sandy loam
#22									
0-15 cm	176.4	0.24	1.0	4.0	6.3	74	12	14	sandy loam
15-30 cm	224.4	0.18	0.7	4.2	4.5	67	19	14	sandy loam
#23									
0-30 cm						75	11	14	sandy loam

*expressed as meq/100g.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8424

WESTERN DIVISION MANAGER
OYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE
139 SOUTH MAIN, HELPER, UTAH
OFFICE TEL (801)

PRICE RIVER COAL CO.
P.O. Box 629
Helper, Utah 84526

Jan. 25, 1980

Sample identification by: Price River Coal Co.
Refuse Pile
1211-UT-9-0027

Kind of sample reported to us: Coal

Sample taken at: Castle Gate Prep. Plant-Refuse Pile

Sample taken by: Price River Coal Co.

Date sampled: 1-16-80

Date received: 1-16-80

Analysis report no. 57-3329

TOXICITY- Following procedure as outlined in the Federal Register, Part IV. Dec. 18, 1978

Arsenic-	0.011 mg/l
Selenium-	less than or = to 0.002 mg/l
Mercury-	less than or = to 0.04 micrograms/l
Cadmium-	less than or = to 0.004 mg/l
Lead-	less than or = to 0.06 mg/l
Cromium-	less than or = to 0.01 mg/l
Silver-	less than or = to 0.01 mg/l
Barium-	0.8 mg/l

ACIDITY- Sample prepared 1:1 coal-water extraction, following procedures of the U.S. Dept. of Agriculture-Handboook 60. Acidity determined as directed in Standard Methods 14th Edition.

Acidity- 0

JE/gp

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Jack Blair,
Manager, Helper Laboratory

Charter

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-4434

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE TO
224 S. CARBON AVE., PRICE, UT 84501
OFFICE TEL. (801) 637-7540

April 25, 1983

PRICE RIVER COAL COMPANY
Robert Wiley
P.O. Box 629
Helper, Utah 84526

Dear Mr. Wiley,

The following is the Analytical Report on the five soil samples we received in our Price Laboratory on March 3, 1983. Also enclosed, please find your analysis.

ANALYTICAL REPORT

Five soil samples were received for analysis on March 3, 1983. These samples were assigned Instrument Analysis Division #97-L493-335-05.

With the exception of the Clay Content results, all analytical data was sent on April 6, 1983.

Clay Content was determined by an external laboratory in accordance with the procedure of the American Society of Agronomy, Monograph 9, Part I, Method 43-5. The results of the determination are presented in Table No. I and are reported in weight percent (WT %) on an "As Received" Basis.

If you have any questions concerning these results, please call.

Sincerely,

COMMERCIAL TESTING & ENGINEERING COMPANY

Jack D. Blair, Assistant Manager
Southwestern Division

JB/dt

Enclosure

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9200

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE
224 S. CARBON AVE., PRICE
OFFICE TEL. (801)

PRICE RIVER COAL CO.
P.O. Box 629
Helper, Utah 84526

April 25, 1983

Sample identification by
Price River Coal Co.

#3 Mine Roof - 57-12619
#3 Mine Floor- 57-12618
#5 Mine Roof - 57-12621
#5 Mine Floor- 57-12620
Refuse - 57-12622

Kind of sample reported to us Soil

Sample taken at Castle Gate Prep Plant

Sample taken by Price River Coal Co.

Date sampled xxxxx

Date received 3-8-83

Analysis report no. 57-12618 thru 57-12622

TABLE NO.I
CLAY CONTENT ANALYSIS
(WT%-As Received)

Sample ID	Sand	Silt	Clay
57-12618	74	14	12
57-12619	86	8	6
57-12620	77	17	6
57-12621	84	10	6
57-12622	69	21	10

JB/dt

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9300

COMMERCIAL TESTING & ENGINEERING CO.

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORR
224 S. CARBON AVE
OFFICE

PRICE RIVER COAL COMPANY
P.O. Box 629
Helper, Utah 84526

April 14, 1983

Kind of sample reported to us Floor

Sample identification by Price River Coal Co.

Sample taken at Castle Gate Prep Plant

#5 Floor

Sample taken by Price River Coal Co.

Date sampled xxxxx

Date received 3-8-83

Analysis report no. 57-12620

MOISTURE AND SULFUR ANALYSIS

	As Received	Dry Basis
% Moisture	0.65	
% Sulfur	0.07	xxxxx
		0.07

SULFUR FORMS

	As Received	Dry Basis
% Pyritic Sulfur	0.01	0.01
% Sulfate Sulfur	0.00	0.00
% Organic Sulfur (Diff)	0.06	0.06
Total	0.07	0.07

JB/dt

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

Final Copy Watermarked For Protection

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9300

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE:
224 S. CARBON AVE., PRICE
OFFICE TEL. 180

PRICE RIVER COAL COMPANY
P.O. Box 629
Helper, Utah 84526

April 14, 1983

Sample identification by
Price River Coal Co.

Kind of sample reported to us: Roof

#5 Mine Roof

Sample taken at: Castle Gate Prep Plant

Sample taken by: Price River Coal Co.

Date sampled: xxxxx

Date received: 3-8-83

Analysis report no. 57-12621

MOISTURE AND SULFUR ANALYSIS

	As Received	Dry Basis
% Moisture	0.74	xxxxx
% Sulfur	0.11	0.11

SULFUR FORMS

	As Received	Dry Basis
% Pyritic Sulfur	0.04	0.04
% Sulfate Sulfur	0.00	0.00
% Organic Sulfur (Diff)	0.07	0.07
Total	0.11	0.11

JB/dt

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210 B, LOMBARD, ILLINOIS 60148 • (312) 953-9300

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORR
224 S. CARBON AVE.
OFFICE T

PRICE RIVER COAL COMPANY
P.O. Box 629
Helper, Utah 84526

April 14, 1983

Kind of sample reported to us: Refuse

Sample identification by: Price River Coal Co.

Refuse

Sample taken at: Castle Gate Prep Plant

Sample taken by: Price River Coal Co.

Date sampled: xxxxx

Date received: 3-8-83

Analysis report no. 57-12622

MOISTURE AND SULFUR ANALYSIS

	As Received	Dry Basis
% Moisture	9.35	xxxxx
% Sulfur	0.41	0.45

SULFUR FORMS

	As Received	Dry Basis
% Pyritic Sulfur	0.17	0.19
% Sulfate Sulfur	0.07	0.08
% Organic Sulfur (Diff)	0.17	0.18
Total	0.41	0.45

JB/dt

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9300

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE
224 S. CARBON AVE., PRICE,
OFFICE TEL. (801

April 14, 1983

PRICE RIVER COAL COMPANY
P.O. Box 629
Helper, Utah 84526

Sample identification by
Price River Coal Co.
#3 Mine Roof

Kind of sample reported to us Roof

Sample taken at Castle Gate Prep Plant

Sample taken by Price River Coal Co.

Date sampled xxxxx

Date received 3-8-83

Analysis report no. 57-12619

MOISTURE AND SULFUR ANALYSIS

	As Received	Dry Basis
% Moisture	0.51	xxxxx
% Sulfur	0.12	0.12

SULFUR FORMS

	As Received	Dry Basis
% Pyritic Sulfur	0.10	0.10
% Sulfate Sulfur	0.00	0.00
% Organic Sulfur (Diff)	0.02	0.02
Total	0.12	0.12

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

JE/dt

Original Copy Watermarked For Your Protection

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953 9300

E SELDON
NAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE TO
224 S. CARBON AVE., PRICE, UT 8450
OFFICE TEL. (801) 637-754

PRICE RIVER COAL COMPANY
P.O. Box 629
Helper, Utah 84526

April 14, 1983

Sample identification by
Price River Coal Co.

Kind of sample reported to us: Floor

#3 Mine Floor

Sample taken at: Castle Gate Prep Plant

Sample taken by: Price River Coal Co.

Date sampled: xxxxx

Date received: 3-8-83

Analysis report no. 57-12618

MOISTURE AND SULFUR ANALYSIS

	As Received	Dry Basis
% Moisture	0.39	xxxxx
% Sulfur	0.07	0.07

SULFUR FORMS

	As Received	Dry Basis
% Pyritic Sulfur	0.01	0.01
% Sulfate Sulfur	0.00	0.00
% Organic Sulfur (Diff)	0.06	0.06
Total	0.07	0.07

JB/ct

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

COMMERCIAL TESTING & ENGINEERING CO.

Reply to
Instrumental Analysis Division
490 Orchard Street
Golden, CO 80401

Phone: 303-278-9

April 6, 1983

Mr. Jack Blair
CT & E
224 S. Carbon Ave.
Price, UT 84501

Re: IAD #97-L493-335-05

Analytical Report

Five soil samples were received for analysis on March 16, 1983. These samples were assigned our IAD identification #97-L493-335-05.

Alkalinity, Salinity, Sodium Adsorption Ratio (SAR) and Specific Conductivity were determined in accordance with the procedures of Agriculture Handbook No. 60, U.S. Department of Agriculture, August 1969. The results of these determinations are presented in Table No. I and are reported in milligrams per litre (mg/L) unless otherwise noted.

A representative portion of each sample was forwarded to an external laboratory for the determination of Clay Content. A separate report will be sent upon completion of the Clay Content determinations.

In accordance with 40 CFR 260 (Federal Register/Vol.45, No.98/ Monday, May 19, 1980) a representative portion (100g) of each sample was extracted for 24 hours using 1600 mL of deionized water. The solutions were pH adjusted using 0.5N acetic acid to a pH of 5.0. At the completion of the extraction,each sample was pressure-filtered through a 0.45 micrometer filter. The filtrate of each sample was then diluted to a final volume of 2000 millilitres including the amount of acetic acid used for pH adjustment.

Sample ID	Sample Weight(g)	Final Filtrate Volume(mL)	Initial pH	Final pH	Volume of 0.5N Acetic Acid(mL)
57-12618	100.0	2000	7.1	5.1	5.5
57-12619	100.0	2000	9.6	4.9	34
57-12620	100.0	2000	9.5	4.9	11
57-12621	100.0	2000	9.9	5.0	15
57-12622	100.0	2000	6.4	5.2	64.5

A summary of the analytical methodology used in the determination of the EPT Toxic Metals is presented in Table No. II. The results of these determinations are presented in Table No. III and are reported in milligrams per litre (mg/L).

Table No. I
(Concentrations in mg/L)

Parameter	57-12618	57-12619	57-12620	57-12621	57-12622
Alkalinity (as $CaCO_3$)	28	224	35	193	415
Salinity (Salt Content)	281	318	510	408	894
Specific Conductivity (umhos/cm)	439	497	797	637	1,397
Calcium	22	100	7.1	80	260
Magnesium	9.8	20	1.9	5.5	28
Sodium	42	40	28	33	20
Sodium Adsorption Ratio (SAR)	1.87	0.96	2.40	0.96	0.31

Table No. II
Summary of Methodology
EP Toxic Extract Determinations

Parameter	Method	Reference
Arsenic	Hydride Generation A. A. Spectrophotometry	EPA*, Method 206.3
Barium	Flame Atomic Absorption Spectrophotometry	EPA*, Method 208.1
Cadmium	Flame Atomic Absorption Spectrophotometry	EPA*, Method 213.1
Chromium	Flame Atomic Absorption Spectrophotometry	EPA*, Method 218.1
Lead	Flame Atomic Absorption Spectrophotometry	EPA*, Method 239.1
Silver	Flame Atomic Absorption Spectrophotometry	EPA*, Method 272.1
Selenium	Hydride Generation A.A. Spectrophotometry	EPA*, Method 270.3
Mercury	Cold Vapor Flameless A.A. Spectrophotometry	EPA*, Method 245.1

Table No. III
EP Toxic Extraction Filtrates
(Concentrations in mg/L)

Parameter	57-12618	57-12619	57-12620	57-12621	57-12522	Minimum Concentration for Characteristic of EP Toxicity
Arsenic	≤0.001	≤0.001	≤0.001	≤0.001	≤0.001	5.0 (D004)*
Barium	0.16	0.25	0.25	0.27	0.39	100.0 (D005)*
Cadmium	≤0.005	≤0.005	≤0.005	≤0.005	≤0.005	1.0 (D006)*
Chromium	≤0.005	≤0.005	≤0.005	≤0.005	≤0.005	5.0 (D007)*
Lead	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	5.0 (D008)*
Mercury	≤0.0002	≤0.0002	≤0.0002	≤0.0002	≤0.0002	0.2 (D009)*
Selenium	≤0.003	≤0.003	≤0.003	≤0.003	≤0.003	1.0 (D010)*
Silver	≤0.004	≤0.004	≤0.004	≤0.004	≤0.004	5.0 (D011)*

*EPA Hazardous Waste Number

If you have any questions concerning these results, please call.

Harold A. Connell
Assistant Laboratory Manager

Robert L. Taylor, Ph.D., Mngr. 6 Jan 83
Instrumental Analysis Division

HAC/gh

LABORATORY ANALYSES REPORT

J. H. M. Laboratories

ANALYTICAL AND CONSULTING LABORATORIES

328 THIRTEENTH STREET
DUNBAR, W. VA 25064
(304) 766-4228

ATTN: Frank L. Pero

Price River Coal Co.

P.O. Box 629

Helper, UT 84526

Analyst Hehman

Lab No. See below

Date Sampled 10/29/80

Date Received 11/6/80

Date Analyzed 11/6/80

Lab Number	39086	39087	39088	
Identification	Thickener sludge	Lubricating oil	Hydraulic oil	
Arsenic	∠0.03	∠0.03	∠0.03	mg/l
Barium	0.2	0.2	0.1	mg/l
Cadmium	0.01	0.32	0.22	mg/l
Chromium	∠ 0.01	0.08	0.09	mg/l
Lead	∠0.1	2.2	1.3	mg/l
Mercury	∠1	∠1	∠1	ug/l
Selenium	∠1	∠1	∠1	ug/l
Silver	∠0.01	0.14	0.05	mg/l

Samples prepared and analyzed according to RCRA EP Toxicity procedure 40CRR 26

DEC 5 1980

Submitted by A. Dayton Carpenter

A. Dayton Carpenter

LABORATORY ANALYSES REPORT

J. H. M. Laboratories

ANALYTICAL AND CONSULTING LABORA

335 THIRTEENTH
DUNBAR, W. VA. 2
(304) 766-

ATTN: Frank Fero

Price River Coal Co.

P.O. Box 629

Helper, UT 84526

Analyst Rehman - Villers

Lab No. See below

Date Sampled See below

Date Received 11/6/80

Date Analyzed 11/6/80

Lab Numbers	39084	39085	
Identification	Refuse Pile	Refuse Pile Retention Pond	
Date Sampled	10/29/80	10/10/80	
Arsenic	<0.03	<0.03	mg/l
Barium	0.3	0.1	mg/l
Cadmium	0.01	<0.01	mg/l
Chromium	<0.01	<0.01	mg/l
Lead	<0.1	<0.1	mg/l
Mercury	<1	<1	ug/l
Selenium	<1	2	ug/l
Silver	<0.01	<0.01	mg/l

Samples prepared and analyzed according to RCRA EP Toxicity procedure 40CFR 261

RECEIVED
DEC 1 1980

Submitted by A. Dayton Carpenter

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

ESTERN DIVISION MANAGER
W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
139 SOUTH MAIN, HELPER, UTAH 84529
OFFICE TEL. (801) 472-353

PRICE RIVER COAL CO.
P.O. Box 629
Helper, Utah 84526

Jan. 25, 1980

Sample identification by: Price River Coal Co.
Refuse Pile
1211-UT-9-0027

Kind of sample reported to us	Coal
Sample taken at	Castle Gate Prep. Plant-Refuse Pile
Sample taken by	Price River Coal Co.
Date sampled	1-16-80
Date received	1-16-80

Analysis report no. 57-3329

TOXICITY- Following procedure as outlined in the Federal Register, Part IV. Dec. 18, 1978

Arsenic- 0.011 mg/1
Selenium- less than or = to 0.002 mg/1
Mercury- less than or = to 0.04 micrograms/1
Cadmium- less than or = to 0.004 mg/1
Lead- less than or = to 0.06 mg/1
Cromium- less than or = to 0.01 mg/1
Silver- less than or = to 0.01 mg/1
Barium- 0.8 mg/1

ACIDITY- Sample prepared 1:1 coal-water extraction, following procedures of the U.S. Dept. of Agriculture-Handboook 60. Acidity determined as directed in Standard Methods 14th Edition.

Acidity- 0

JE/gp

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Jack Blair,
Manager, Helper Laboratory

Charter Member

COMPARISON OF CHEMICAL ANALYSES OF COAL REFUSE AND ROCK WASTE IN HARDSCRABBLE CANYON AT GOOSE ISLAND

Description of Material

Coal Refuse: Deposited at location during operation of Diamanti coal tipple (1950 - 1975) - coal fines, rock fines, rock boulders Rock is from No. 5 Mine - Texture: sand - sandy

Rock Waste: Deposited during 1978 - 1979 by Braztah Corporation from No. 3 Mine floor for purpose of refuse covering material - Texture: sand

	MATERIAL: COAL REFUSE					MATERIAL: ROCK WASTE	
Sample Dates →	1-25-80	6-2-82	4-25-83 #5 Roof	4-25-83 #5 Floor	2-29-84	4-25-83 #3 Mine Floor	2-29-84
AS	0.011	--	0.001	0.001	--	0.001	--
Se	0.002	--	0.003	0.003	--	0.003	--
Hg	0.04	--	0.0002	0.0002	--	0.001	--
Cd	0.004	--	0.005	0.005	--	0.005	--
Pd	0.06	--	0.05	0.05	--	0.05	--
Cr	0.01	--	0.005	0.005	--	0.005	--
Ag	0.01	--	0.004	0.004	--	0.004	--
Ba	0.8	--	0.27	0.25	--	0.16	--
K	--	0.22	--	--	--	--	--
Na	--	0.34	5.5	1.9	--	42	--
Ca	--	37.0	80	7.1	--	22	--
Mg	--	2.18	5.5	1.9	--	9.8	--
B	--	200.4	--	--	--	--	--
CL	--	0.15	--	--	--	--	--
SO_4	--	1.35	--	--	--	--	--
HCO_3	--	0.11	--	--	--	--	--
%K	--	0.22	--	--	--	--	--
NO_3-N	--	0.85	--	--	--	--	--
P	--	4.1	--	--	--	--	--
Organic Matter %	--	5.4	--	--	--	--	--
pH	--	8.45	--	--	7.7	--	--
EC	--	29.5	--	--	--	--	--
SAR	--	0.24	0.96	2.4	3.85	1.87	1.67
S-Tot	--	--	0.11	0.07	0.18	0.07	0.31
ALK	--	--	193	35	101	28	55
Salinity	--	--	408 (Mg/L)	510 (Mg/L)	0.05 (%)	281 (Mg/L)	0.20 (%)
Acid	0	--	--	--	0	--	--
Spec.Cond.	--	--	637	--	820	439	3,200

COMPARISON OF CHEMICAL ANALYSES OF COAL REFUSE AND ROCK WASTE IN HARDSCRABBLE CANYON AT GOOSE ISLAND

Description of Material

Coal Refuse: Deposited at location during operation of Diamanti coal tipple (1950 - 1975) - coal fines, rock fines, rock boulders
Rock is from No. 5 Mine - Texture: sand - sandy

Rock Waste: Deposited during 1978 - 1979 by Braztah Corporation from No. 3 Mine floor for purpose of refuse covering material - Texture: sand

	MATERIAL: COAL REFUSE					MATERIAL: ROCK WASTE	
Sample Dates =	1-25-80	6-2-82	4-25-83 #5 Roof	4-25-83 #5 Floor	2-29-84	4-25-83 #3 Mine Floor	2-29-84
AS	0.011	--	0.001	0.001	--	0.001	--
Se	0.002	--	0.003	0.003	--	0.003	--
Hg	0.04	--	0.0002	0.0002	--	0.001	--
Cd	0.004	--	0.005	0.005	--	0.005	--
Pd	0.06	--	0.05	0.05	--	0.05	--
Cr	0.01	--	0.005	0.005	--	0.005	--
Ag	0.01	--	0.004	0.004	--	0.004	--
Ba	0.8	--	0.27	0.25	--	0.16	--
K	--	0.22	--	--	--	--	--
Na	--	0.34	5.5	1.9	--	42	--
Ca	--	37.0	80	7.1	--	22	--
Mg	--	2.18	5.5	1.9	--	9.8	--
B	--	200.4	--	--	--	--	--
CL	--	0.15	--	--	--	--	--
SO_4	--	1.35	--	--	--	--	--
HCO_3	--	0.11	--	--	--	--	--
%K	--	0.22	--	--	--	--	--
NO_3-N	--	0.85	--	--	--	--	--
P	--	4.1	--	--	--	--	--
Organic Matter %	--	5.4	--	--	--	--	--
pH	--	8.45	--	--	7.7	--	--
EC	--	29.5	--	--	--	--	--
SAR	--	0.24	0.96	2.4	3.85	1.87	1.67
S-Tot	--	--	0.11	0.07	0.18	0.07	0.31
ALK	--	--	193	35	101	28	55
Salinity	--	--	408 (Mg/L)	510 (Mg/L)	0.05 (%)	281 (Mg/L)	0.20 (%)
Acid	0	--	--	--	0	--	--
Spec.Cond.	--	--	637	--	820	439	3,200

iml

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6777	1-A	0.0-0.5	7.5	0.70	28.0	4.93	1.98	2.05	1.10	45.0	62.0	28.9	9.1	SANDY LOAM
6778	B	0.5-1.0	7.7	0.81	26.5	5.66	3.04	1.75	0.84	43.3	65.1	25.8	9.1	SANDY LOAM
6779	C	1.0-2.0	7.4	1.98	30.3	15.0	9.36	4.49	1.29	71.1	83.8	13.5	2.7	LOAMY SAND
6780	D	2.0-3.0	7.5	2.41	26.4	13.5	8.43	5.86	1.77	67.1	76.5	18.0	5.5	LOAMY SAND
6781	E	3.0-4.0	7.5	3.57	29.8	19.0	11.8	14.6	3.72	63.2	80.9	15.5	3.6	LOAMY SAND
6782	2-A	0.0-0.5	7.7	0.56	25.8	3.85	1.56	1.45	0.88	34.2	68.2	24.5	7.3	SANDY LOAM
6783	B	0.5-1.0	7.5	1.36	25.5	8.03	4.51	4.13	1.65	44.6	69.3	25.2	5.5	SANDY LOAM
6784	C	1.0-2.0	7.6	4.57	27.2	16.0	12.9	22.7	5.97	74.9	82.7	16.4	0.9	LOAMY SAND
6785	D	2.0-3.0	7.5	4.79	28.8	17.8	12.4	24.6	6.33	73.3	81.8	15.5	2.7	LOAMY SAND
6786	E	3.0-4.0	7.4	5.15	29.5	17.8	14.3	26.1	6.51	62.0	78.2	18.2	3.6	LOAMY SAND
6787	3-A	0.0-0.5	7.5	0.82	28.9	5.48	2.56	1.81	0.90	24.0	63.6	29.5	6.9	SANDY LOAM
6788	B	0.5-1.0	7.6	1.54	28.9	8.79	5.37	1.63	0.61	28.7	66.9	24.9	8.2	SANDY LOAM
6789	3-6(C)	1.0-2.0	7.0	3.66	34.2	22.5	22.6	2.01	0.42	69.2	87.3	11.8	0.9	SAND
6790	D	2.0-3.0	7.3	3.82	28.5	23.0	22.5	4.47	0.94	62.3	81.8	15.5	2.7	LOAMY SAND
6791	E	3.0-4.0	7.5	3.39	30.8	17.4	14.9	7.71	1.92	62.7	79.1	18.2	2.7	LOAMY SAND
6792	4-A	0.0-0.5	7.7	2.04	26.8	12.0	8.14	2.09	0.66	41.6	69.6	24.0	6.4	SANDY LOAM
6793	B	0.5-1.0	7.8	2.49	29.2	17.3	13.7	4.13	1.05	36.2	64.5	26.4	9.1	SANDY LOAM
6794	C	1.0-2.0	7.5	3.10	27.2	15.5	12.5	6.93	1.85	66.1	80.0	18.2	1.8	LOAMY SAND
6795	D	2.0-3.0	7.6	3.38	31.9	15.7	11.4	12.5	3.40	65.2	83.3	14.0	2.7	LOAMY SAND
6796	E	3.0-4.0	7.9	2.72	31.2	6.08	4.59	16.8	7.27	57.8	87.5	11.6	0.9	SAND

REVISED SEP 1991

Appendix

Miscella[redacted] breviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Cap[redacted] ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= A[redacted] le

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6777	1-A	0.0-0.5	3.3	-0.01	220.	<0.01	<0.01	<0.01	-0.01	220.	5.57	0.35	6.00	5.94
6778	B	0.5-1.0	2.4	-0.01	256.	<0.01	<0.01	<0.01	-0.01	256.	6.05	0.25	5.00	4.95
6779	C	1.0-2.0	17.0	0.25	92.0	<0.01	0.10	0.15	3.12	88.9	5.33	1.56	11.0	10.9
6780	D	2.0-3.0	11.1	0.20	110.	<0.01	0.09	0.11	2.81	107.	4.64	0.49	13.0	12.8
6781	E	3.0-4.0	5.7	0.36	83.3	0.05	0.14	0.17	4.37	79.0	5.37	0.75	24.0	23.6
6782	2-A	0.0-0.5	3.1	-0.01	218.	<0.01	<0.01	<0.01	-0.01	218.	7.39	0.34	5.00	4.96
6783	B	0.5-1.0	5.5	0.04	211.	<0.01	0.01	0.03	0.31	211.	5.33	0.50	11.0	10.9
6784	C	1.0-2.0	13.5	0.24	87.8	<0.01	0.09	0.15	2.81	85.0	4.16	0.44	42.0	41.4
6785	D	2.0-3.0	15.0	0.29	92.2	<0.01	0.14	0.15	4.37	87.8	5.77	0.70	45.0	44.3
6786	E	3.0-4.0	17.0	0.50	88.5	0.02	0.28	0.20	8.75	79.8	3.95	0.99	46.0	45.2
6787	3-A	0.0-0.5	3.0	0.03	169.	<0.01	<0.01	0.03	-0.01	169.	8.28	0.36	5.00	4.95
6788	B	0.5-1.0	2.0	-0.01	173.	<0.01	<0.01	<0.01	-0.01	173.	5.17	0.32	5.00	4.95
6789	3-6(C)	1.0-2.0	10.7	0.65	65.4	0.33	0.14	0.18	4.37	61.0	4.56	1.03	10.0	9.93
6790	D	2.0-3.0	10.9	0.43	78.3	0.14	0.13	0.16	4.06	74.3	5.04	0.58	12.0	11.9
6791	E	3.0-4.0	16.1	0.34	79.3	<0.01	0.12	0.22	3.75	75.5	7.39	1.06	18.0	17.8
6792	4-A	0.0-0.5	7.4	0.13	124.	<0.01	0.05	0.08	1.56	123.	6.38	0.82	8.00	7.94
6793	B	0.5-1.0	5.3	0.08	128.	0.01	0.03	0.04	0.94	127.	4.76	0.40	12.0	11.9
6794	C	1.0-2.0	13.1	0.28	80.1	<0.01	0.13	0.15	4.06	76.0	5.69	0.98	21.0	20.8
6795	D	2.0-3.0	17.5	0.30	74.8	<0.01	0.10	0.20	3.12	71.7	4.76	0.68	23.0	22.6
6796	E	3.0-4.0	17.7	0.34	63.4	<0.01	0.08	0.26	2.50	60.9	4.96	0.62	35.0	34.5

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

Inter-Mountain Laboratories, Inc.
2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H20 Sol Selenium ppm	Total Kjeldahl Nitrogen %
6777	1-A	0.0-0.5	1.8	0.1	10.8	6.1	<0.01	0.08
6778	B	0.5-1.0	1.8	0.1	10.4	6.0	<0.01	0.04
6779	C	1.0-2.0			9.0	5.5	0.06	0.39
6780	D	2.0-3.0			9.3	6.1	0.02	0.27
6781	E	3.0-4.0			9.8	6.6	0.03	0.41
6782	2-A	0.0-0.5	2.2	0.1	10.6	5.5	<0.01	0.06
6783	B	0.5-1.0	2.2	0.1	9.6	5.8	<0.01	0.08
6784	C	1.0-2.0			8.8	5.1	0.14	0.34
6785	D	2.0-3.0			10.6	5.9	0.03	0.38
6786	E	3.0-4.0			12.8	6.5	0.03	0.41
6787	3-A	0.0-0.5	2.0	0.1	12.6	6.3	<0.01	0.10
6788	B	0.5-1.0	1.8	0.1	12.1	6.1	<0.01	0.05
6789	3-6(C)	1.0-2.0			7.8	5.1	0.10	0.35
6790	D	2.0-3.0			9.1	4.9	0.03	0.36
6791	E	3.0-4.0			10.6	5.1	0.01	0.53
6792	4-A	0.0-0.5	1.9	0.1	11.6	6.4	<0.01	0.17
6793	B	0.5-1.0	1.9	0.1	13.3	6.8	0.01	0.10
6794	C	1.0-2.0			9.6	5.2	0.02	0.35
6795	D	2.0-3.0			10.7	4.7	<0.01	0.53
6796	E	3.0-4.0			6.8	4.4	<0.01	0.65

* Air dry bulk density was substituted for 1/3 bar bulk density in calculations.
Abbreviati[illegible] extractants: PE= Saturated Paste Extract, H2OSol= water soluble, ABF [illegible]monium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

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Appendix

Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6797	5-A	0.0-0.5	7.7	1.58	27.1	7.91	4.43	2.48	1.00	35.7	70.9	22.7	6.4	SANDY LOAM
6798	B	0.5-1.0	7.7	1.22	29.1	6.81	3.49	1.62	0.71	31.8	63.6	30.0	6.4	SANDY LOAM
6799	C	1.0-2.0	7.4	3.38	29.7	18.1	11.4	8.59	2.24	58.4	78.2	18.2	3.6	LOAMY SAND
6800	D	2.0-3.0	7.3	3.54	28.8	17.1	12.1	10.1	2.64	65.3	82.0	14.4	3.6	LOAMY SAND
6801	E	3.0-4.0	7.6	3.58	30.9	11.2	6.55	19.4	6.51	71.3	84.7	13.5	1.8	LOAMY SAND
6802	6-A	0.0-0.5	7.6	2.15	27.7	12.6	6.80	3.33	1.07	34.1	65.5	26.3	8.2	SANDY LOAM
6803	B	0.5-1.0	7.7	3.49	28.1	18.7	13.9	7.56	1.87	38.5	67.8	24.0	8.2	SANDY LOAM
6804	C	1.0-2.0	7.7	4.46	32.3	17.8	12.8	20.9	5.34	62.5	76.4	20.9	2.7	LOAMY SAND
6805	D	2.0-3.0	7.6	4.77	32.5	14.4	10.0	27.6	7.90	68.7	81.8	16.4	1.8	LOAMY SAND
6806	E	3.0-4.0	7.8	3.60	31.4	6.80	5.09	24.9	10.2	61.6	80.0	17.8	2.2	LOAMY SAND
6807	7-A	0.0-0.5	7.8	0.88	27.4	4.45	1.99	1.65	0.92	37.3	63.3	29.4	7.3	SANDY LOAM
6808	B	0.5-1.0	7.6	2.21	28.8	13.2	7.74	2.76	0.85	39.7	67.5	25.2	7.3	SANDY LOAM
6809	C	1.0-2.0	7.4	3.73	30.8	19.2	13.4	9.38	2.32	64.7	74.7	19.8	5.5	SANDY LOAM
6810	D	2.0-3.0	7.4	3.62	32.0	19.3	13.1	8.38	2.08	62.9	88.2	7.6	4.2	SAND
6811	E	3.0-4.0	7.5	3.77	30.4	17.8	11.4	14.0	3.66	70.4	87.3	7.8	4.9	LOAMY SAND

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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Appendix 8

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Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6797	5-A	0.0-0.5	5.3	0.06	195.	<0.01	<0.01	0.06	-0.01	195.	10.4	0.52	8.00	7.93
6798	B	0.5-1.0	5.0	-0.01	186.	<0.01	<0.01	<0.01	-0.01	186.	5.37	0.49	6.00	5.95
6799	C	1.0-2.0	11.6	0.40	102.	<0.01	0.20	0.20	6.25	95.7	3.51	0.63	20.0	19.7
6800	D	2.0-3.0	16.0	0.42	68.9	<0.01	0.22	0.20	6.87	62.0	5.57	0.69	24.0	23.7
6801	E	3.0-4.0	17.0	0.57	64.8	0.01	0.32	0.24	10.0	54.8	5.49	0.87	40.0	39.4
6802	6-A	0.0-0.5	3.6	0.06	144.	<0.01	0.01	0.05	0.31	144.	6.38	0.45	9.00	8.91
6803	B	0.5-1.0	5.4	0.09	146.	<0.01	0.05	0.04	1.56	145.	5.17	0.58	16.0	15.8
6804	C	1.0-2.0	16.2	0.33	91.5	<0.01	0.14	0.19	4.37	87.2	5.12	0.79	37.0	36.3
6805	D	2.0-3.0	15.6	0.37	66.6	<0.01	0.17	0,20	5.31	61.2	5.12	1.67	52.0	51.1
6806	E	3.0-4.0	15.6	0.36	71.2	<0.01	0.13	0.23	4.06	67.1	6.13	1.04	66.0	65.2
6807	7-A	0.0-0.5	3.0	0.07	161.	<0.01	0.01	0.06	0.31	160.	4.36	0.40	5.00	4.95
6808	B	0.5-1.0	5.7	0.05	143.	<0.01	<0.01	0.05	-0.01	143.	4.16	0.71	9.00	8.92
6809	C	1.0-2.0	17.6	0.26	107.	<0.01	0.08	0.18	2.50	105.	5.17	1.50	20.0	19.7
6810	D	2.0-3.0	12.7	0.39	85.0	0.04	0.14	0.21	4.37	80.6	3.55	0.96	19.0	18.7
6811	E	3.0-4.0	15.9	0.34	77.3	0.02	0.15	0.17	4.69	72.6	4.36	1.57	27.0	26.6

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscella[redacted] reviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capa[redacted] SP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Ava[redacted] e

Appendix C

Inter-Mountain Laboratories, Inc.
2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
6797	5-A	0.0-0.5	1.8	0.1	11.1	5.0	<0.01	0.16
6798	B	0.5-1.0	2.1	0.1	12.5	5.4	<0.01	0.09
6799	C	1.0-2.0	2.1	0.1	10.8	4.9	0.03	0.36
6800	D	2.0-3.0			8.2	4.9	0.02	0.41
6801	E	3.0-4.0			8.3	4.5	0.03	0.41
6802	6-A	0.0-0.5	2.0	0.1	11.4	5.4	0.01	0.09
6803	B	0.5-1.0	2.0	0.1	11.8	5.9	0.02	0.09
6804	C	1.0-2.0			10.6	5.7	0.03	0.37
6805	D	2.0-3.0			9.4	5.1	0.03	0.45
6806	E	3.0-4.0			13.0	5.1	0.03	0.47
6807	7-A	0.0-0.5	1.7	0.1	10.9	5.1	<0.01	0.13
6808	B	0.5-1.0			11.2	5.7	0.06	0.10
6809	C	1.0-2.0			9.8	5.5	0.08	0.32
6810	D	2.0-3.0			12.0	5.1	0.07	0.40
6811	E	3.0-4.0			12.2	5.1	0.04	0.35

* Air dry bulk density was substiuted for 1/3 bar bulk density in calculations.
Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble,ABPTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

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Appendix

Inter-Mountain Laboratories, Inc.

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CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6786	E	3.0-4.0	7.4	5.15	29.5	17.8	14.3	26.1	6.51	62.0	78.2	18.2	3.6	LOAMY SAND
6813	6786(DUP)	3.0-4.0	7.3	5.05	29.5	18.0	13.9	25.1	6.28		83.6	13.3	3.1	LOAMY SAND
6789	3-6(C)	1.0-2.0	7.0	3.66	34.2	22.5	22.6	2.01	0.42	69.2	87.3	11.8	0.9	SAND
6814	6789(DUP)	1.0-2.0	6.9	3.84	32.9	21.6	23.7	2.26	0.47		89.1	8.7	2.2	SAND
6799	C	1.0-2.0	7.4	3.38	29.7	18.1	11.4	8.59	2.24	58.4	78.2	18.2	3.6	LOAMY SAND
6815	6799(DUP)	1.0-2.0	7.4	3.54	29.8	19.1	12.2	9.04	2.29		84.0	12.9	3.1	LOAMY SAND

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Appendix 8

Miscella[redacted]breviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Cap[redacted]SP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Av[redacted]le

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6786	E	3.0-4.0	17.0	0.50	88.5	0.02	0.28	0.20	8.75	79.8	3.95	0.99	46.0	45.2
6813	6786(DUP)	3.0-4.0	17.1								4.76	1.05		
6789	3-6(C)	1.0-2.0	10.7	0.65	65.4	0.33	0.14	0.18	4.37	61.0	4.56	1.03	10.0	9.93
6814	6789(DUP)	1.0-2.0	11.0	0.71	64.5	0.36	0.15	0.20	4.69	59.9	5.21	0.60	10.0	9.93
6799	C	1.0-2.0	11.6	0.40	102.	<0.01	0.20	0.20	6.25	95.7	3.51	0.63	20.0	19.7
6815	6799(DUP)	1.0-2.0	11.6	0.39	101.	<0.01	0.22	0.17	6.87	94.1	4.28	0.74	19.0	18.7

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

imi
Inter-Mountain Laboratories, Inc.
2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

LOCATION: School House Canyon

DATE REPORTED: June 19, 1990

Refuse Site

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
6786	E	3.0-4.0			12.8	6.5	0.03	0.41
6813	6786(DUP)	3.0-4.0					0.02	
6789	3-6(C)	1.0-2.0			7.8	5.1	0.10	0.35
6814	6789(DUP)	1.0-2.0			6.6	4.5	0.10	0.30
6799	C	1.0-2.0	2.1		10.8	4.9	0.03	0.36
6815	6799(DUP)	1.0-2.0			7.5	4.8	0.05	0.32

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Appendix

* Air dry bulk density was substituted for 1/3 bar in calculations.
Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

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Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

PP = Preparation Plant Area
H = Hardscrabble Canyon
S = Sowbelly Canyon

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6816	PP #1	0.0-4.0	7.4	1.97	32.9	8.81	11.1	3.84	1.22	42.9	63.6	27.9	8.5	SANDY LOAM
6817	#2	0.0-4.0	7.6	4.77	40.5	17.8	41.5	15.2	2.79	36.1	52.2	35.6	12.2	SANDY LOAM
6818	PP #(3&4)	0.0-4.0	7.8	1.23	39.2	3.29	3.88	4.22	2.23	33.7	60.0	31.5	8.5	SANDY LOAM
6819	#5	0.0-4.0	8.2	0.65	28.5	1.25	1.58	4.81	4.04	53.0	60.0	28.5	11.5	SANDY LOAM
6820	#6	0.0-4.0	8.2	2.39	31.3	1.99	8.98	14.2	6.06	23.6	57.3	31.4	11.3	SANDY LOAM
6821	#7	0.0-4.0	7.6	0.54	32.8	2.65	1.49	1.27	0.88	22.6	73.6	21.3	5.1	SANDY LOAM
6822	#8	0.0-4.0	7.5	2.28	33.2	12.3	7.91	3.08	0.97	29.9	58.7	32.6	8.7	SANDY LOAM
6823	H-1	0.0-4.0	8.0	0.55	28.5	1.98	0.57	4.08	3.61	46.2	65.1	27.1	7.8	SANDY LOAM
6824	2	0.0-4.0	7.3	4.65	37.0	24.3	23.6	8.29	1.69	57.7	62.4	29.8	7.8	SANDY LOAM
6825	3	0.0-4.0	7.7	1.30	34.5	3.14	2.49	6.64	3.96	55.1	60.5	31.7	7.8	SANDY LOAM
6826	4	0.0-4.0	7.7	0.41	31.6	2.46	1.36	1.08	0.78	58.2	54.2	29.8	16.0	SANDY LOAM
6827	5	0.0-4.0	7.8	0.57	32.5	2.79	2.13	1.92	1.22	57.6	54.2	34.3	11.5	SANDY LOAM
6828	6	0.0-4.0	7.8	1.00	33.7	2.84	4.47	4.18	2.19	44.7	56.0	32.5	11.5	SANDY LOAM
6829	7	0.0-4.0	7.5	2.67	30.7	15.9	11.0	5.06	1.38	52.2	61.5	28.9	9.6	SANDY LOAM
6830	S-1	0.0-4.0	7.9	0.93	34.7	3.11	3.82	3.58	1.92	37.3	51.5	33.6	14.9	LOAM
6831	2	0.0-4.0	7.4	4.50	39.5	14.7	28.6	7.52	1.62	42.9	46.9	38.0	15.1	LOAM
6832	3	0.0-4.0	7.5	1.66	46.5	5.22	7.71	7.50	2.95	32.5	42.4	40.7	16.9	LOAM
6833	4	0.0-4.0	7.8	3.99	41.6	17.6	38.9	13.9	2.62	19.6	40.5	42.6	16.9	LOAM
6834	5	0.0-2.5	7.8	1.76	35.1	4.55	9.30	4.71	1.79	65.8	60.5	29.0	10.5	SANDY LOAM
6835	6	0.0-4.0	7.7	2.23	39.6	6.29	11.6	4.76	1.59	30.2	47.8	37.1	15.1	LOAM

Appendix C

Miscell... Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cati... Exchange Capacity, ESP= Exchangeable Sodium P...

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

PP = Preparation Plant Area
H = Hardscrabble Canyon
S = Sowbelly Canyon

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6816	PP #1	0.0-4.0	9.2	0.07	92.2	<0.01	0.01	0.06	0.31	91.9	8.40	1.84	13.0	12.9
6817	#2	0.0-4.0	5.5	0.19	137.	0.13	0.01	0.05	0.31	137.	8.19	0.93	75.0	74.4
6818	PP #(3&4)	0.0-4.0	5.5	0.07	124.	0.01	0.01	0.05	0.31	124.	5.08	4.00	16.0	15.8
6819	#5	0.0-4.0	<0.1	0.03	191.	<0.01	0.01	0.02	0.31	191.	4.56	0.33	18.0	17.9
6820	#6	0.0-4.0	2.6	0.03	126.	<0.01	0.01	0.02	0.31	126.	5.77	0.66	30.0	29.6
6821	#7	0.0-4.0	3.3	-0.01	213.	<0.01	<0.01	<0.01	-0.01	213.	5.45	2.21	7.00	6.96
6822	#8	0.0-4.0	1.6	0.03	140.	0.03	<0.01	<0.01	-0.01	140.	40.7	0.59	9.00	8.90
6823	H-1	0.0-4.0	2.9	0.03	99.1	<0.01	0.01	0.02	0.31	98.8	6.42	0.69	16.0	15.9
6824	2	0.0-4.0	5.3	0.38	99.5	0.23	0.03	0.12	0.94	98.6	7.35	1.01	20.0	19.7
6825	3	0.0-4.0	9.7	0.20	88.0	0.10	0.03	0.07	0.94	87.0	7.43	1.52	23.0	22.8
6826	4	0.0-4.0	8.1	0.05	98.5	<0.01	<0.01	0.05	-0.01	98.5	7.99	0.42	5.00	4.97
6827	5	0.0-4.0	10.2	0.08	97.4	<0.01	0.01	0.07	0.31	97.1	7.10	1.04	10.0	9.94
6828	6	0.0-4.0	5.2	0.03	77.7	<0.01	<0.01	0.03	-0.01	77.7	5.61	1.15	14.0	13.9
6829	7	0.0-4.0	8.0	0.13	68.1	<0.01	0.02	0.11	0.62	67.5	6.98	0.92	13.0	12.8
6830	S-1	0.0-4.0	2.6	-0.01	72.2	<0.01	<0.01	<0.01	-0.01	72.2	13.4	0.70	13.0	12.9
6831	2	0.0-4.0	4.8	0.05	134.	0.01	0.01	0.03	0.31	134.	5.29	0.95	21.0	20.7
6832	3	0.0-4.0	8.1	0.06	95.9	0.01	<0.01	0.05	-0.01	95.9	5.89	0.95	33.0	32.7
6833	4	0.0-4.0	3.6	0.08	77.5	0.04	0.01	0.03	0.31	77.2	4.72	0.65	32.0	31.4
6834	5	0.0-2.5	6.5	0.03	126.	<0.01	<0.01	0.03	-0.01	126.	4.44	1.14	14.0	13.8
6835	6	0.0-4.0	5.3	0.04	87.9	0.01	0.01	0.02	0.31	87.6	10.4	0.70	15.0	14.8

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. = Neutralization Potential

Miscellaneous abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capac[illegible], ESP= Exchangeable Sodium Perc[illegible]

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Appendix 8

imL

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990
PP = Preparation Plant Area
H = Hardscrabble Canyon
S = Sowbelly Canyon

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in *	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
6816	PP #1	0.0-4.0	1.8	0.1	11.7	7.3	<0.01	0.17
6817	#2	0.0-4.0	2.4	0.1	15.0	9.9	<0.01	0.09
6818	PP #(3&4)	0.0-4.0	2.3	0.1	12.1	7.0	<0.01	0.12
6819	#5	0.0-4.0	2.4	0.1	9.6	5.6	<0.01	0.05
6820	#6	0.0-4.0	2.2	0.1	10.7	6.8	<0.01	0.04
6821	#7	0.0-4.0	2.0	<0.1	6.9	5.6	<0.01	0.05
6822	#8	0.0-4.0	2.4	0.1	10.2	6.6	<0.01	0.07
6823	H-1	0.0-4.0	2.1	<0.1	10.2	6.3	<0.01	0.06
6824	2	0.0-4.0	1.7	<0.1	12.4	7.4	<0.01	0.27
6825	3	0.0-4.0	1.7	<0.1	12.4	7.6	<0.01	0.20
6826	4	0.0-4.0	2.0	0.1	19.7	9.0	<0.01	0.11
6827	5	0.0-4.0	2.1	0.1	20.9	9.0	<0.01	0.17
6828	6	0.0-4.0	2.3	0.1	18.8	8.7	<0.01	0.08
6829	7	0.0-4.0	2.4	0.1	16.4	7.3	0.03	0.21
6830	S-1	0.0-4.0	2.6	0.2	20.7	8.0	<0.01	0.06
6831	2	0.0-4.0	2.1	0.1	20.5	10.2	<0.01	0.07
6832	3	0.0-4.0	3.1	0.2	21.9	11.7	<0.01	0.11
6833	4	0.0-4.0	2.6	0.3	23.4	9.7	<0.01	0.05
6834	5	0.0-2.5	2.5	0.1	21.2	6.8	<0.01	0.08
6835	6	0.0-4.0	2.2	0.2	23.3	9.0	<0.01	0.08

* Air dry bulk density was substituted for 1/3 bar bulk density in calculations.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, [illegible]

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Appendix 8

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Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Sowbelly Canyon

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6836	7	0.0-4.0	7.3	28.8	30.0	40.3	25.4	187.	32.6	56.5	61.3	30.0	8.7	SANDY LOAM

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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Appendix 8

Inter-Mountain Laboratories, Inc.
2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Sowbelly Canyon

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6836	7	0.0-4.0	4.7	-0.01	98.1	<0.01	<0.01	<0.01	-0.01	98.1	4.72	0.36	226.	220.

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Appendix 8

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Sowbelly Canyon

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
6836	7	0.0-4.0	2.3	0.1	19.1	6.7	<0.01	0.04

* Air dr[redacted] nsity was substituted for 1/3 bar bulk density in calculations.
Abbreviat[redacted] r extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB[redacted] Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

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Appendix 8

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Preparation Plant Area

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
6819	#5	0.0-4.0	8.2	0.65	28.5	1.25	1.58	4.81	4.04	53.0	60.0	28.5	11.5	SANDY LOAM
6838	6819(DUP)	0.0-4.0	8.2	0.65	27.7	1.04	1.32	4.45	4.10		61.3	27.2	11.5	SANDY LOAM
6820	#6	0.0-4.0	8.2	2.39	31.3	1.99	8.98	14.2	6.06	23.6	57.3	31.4	11.3	SANDY LOAM
6839	6820(DUP)	0.0-4.0	8.2	1.94	32.5	2.04	8.46	12.8	5.59		58.7	30.8	10.5	SANDY LOAM

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Appendix 8

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Preparation Plant Area

Lab No.	Location	Depths	Organic Matter %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm	Avail Na meq/100g	Exch Na meq/100g
6819	#5	0.0-4.0	<0.1	0.03	191.	<0.01	0.01	0.02	0.31	191.	4.56	0.33	18.0	17.9
6838	6819(DUP)	0.0-4.0	0.3	0.03	191.	<0.01	0.01	0.02	0.31	191.	4.76	0.27	17.0	16.9
6820	#6	0.0-4.0	2.6	0.03	126.	<0.01	0.01	0.02	0.31	126.	5.77	0.66	30.0	29.6
6839	6820(DUP)	0.0-4.0	2.9	0.03	126.	<0.01	0.01	0.02	0.31	126.	5.77	0.69	32.0	31.6

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Appendix 8

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Neutralization Potential

Miscellaneous abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capa. ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Av

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Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CASTLE GATE COAL COMPANY
HELPER, UTAH

DATE REPORTED: June 19, 1990

Preparation Plant Area

Lab No.	Location	Depths	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
6819	#5	0.0-4.0	2.4		9.6	5.6	<0.01	0.05
6838	6819(DUP)	0.0-4.0			10.1	7.2	<0.01	0.05
6820	#6	0.0-4.0	2.2		10.7	6.8	<0.01	0.04
6839	6820(DUP)	0.0-4.0			10.5	7.3	<0.01	0.04

* Air dry bulk density was substituted for 1/3 bar bulk density in calculations.
Abbreviations for extractants: PF= Saturated Paste Extract, H2OSol= water soluble, AB-DTA= Ammonium Bicarbonate-DTPA, AAD= Acid [illegible]

REVISED SEP 1991

Appendix 8

Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
11993	L-7	0-6	7.7	1.33	29.4	4.38	3.39	3.22	1.63	16.7	58.0	33.8	8.2	SANDY LOAM
11994		6-12	7.7	2.69	34.8	5.95	5.57	11.1	4.63	22.2	48.0	36.2	15.8	LOAM
11995		12-24	7.6	4.49	32.7	12.6	11.3	11.3	3.27	21.7	45.5	41.3	13.2	LOAM
11996		24-36	7.5	2.68	32.5	9.82	5.63	7.01	2.52	25.5	55.5	34.0	10.5	SANDY LOAM
11997		36-48	7.2	3.00	35.6	13.6	6.29	2.87	0.91	30.0	54.2	37.8	8.0	SANDY LOAM
11998	M-7	0-6	7.9	3.57	29.6	5.37	6.28	19.5	8.08	37.1	60.5	34.0	5.5	SANDY LOAM
11999		6-12	7.7	4.67	31.8	8.28	14.2	17.3	5.16	22.0	50.5	36.5	13.0	LOAM
12000		12-18	7.6	3.19	27.4	8.26	10.2	6.67	2.20	61.2	64.2	27.8	8.0	SANDY LOAM
12001		18-24	7.7	1.33	27.8	4.79	2.46	2.14	1.12	75.0	70.5	23.8	5.7	SANDY LOAM
12002		24-30	7.8	1.04	26.9	3.73	1.52	1.69	1.04	60.4	70.5	23.8	5.7	SANDY LOAM
12003		30-36	7.8	0.58	28.3	2.61	0.99	0.99	0.74	34.1	49.2	41.3	9.5	LOAM
12004		36-48	7.6	0.79	28.5	3.22	1.21	1.31	0.88	47.1	68.0	23.8	8.2	SANDY LOAM
12005	U-7	0-6	7.8	30.6	33.8	9.83	4.93	298.	110.	40.3	70.5	21.3	8.2	SANDY LOAM
12005A		6-12	7.7	45.7	29.5	8.79	4.04	515.	203.	28.3	58.2	31.0	10.8	SANDY LOAM
12006		12-18	7.6	82.1	27.1	12.0	4.20	900.	316.	36.4	63.8	28.0	8.2	SANDY LOAM
12007		18-24	7.7	79.6	27.6	10.7	3.82	845.	314.	24.5	63.2	26.0	10.8	SANDY LOAM
12008		24-30	7.7	81.8	29.6	10.2	3.73	794.	301.	35.7	63.2	27.3	9.5	SANDY LOAM
12009		30-36	7.7	85.1	29.3	10.8	3.72	904.	336.	32.1	65.5	25.0	9.5	SANDY LOAM
12010		36-48	7.7	103.	27.1	12.9	4.17	1055.	361.	52.1	78.0	16.3	5.7	LOAMY SAND

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L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample S-7

Miscella[illegible]breviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Cap[illegible]ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= A[illegible]le

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Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	Organic Carbon %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm
11993	L-7	0-6	3.8	-0.01	84.0	<0.01	<0.01	<0.01	-0.01	84.0	11.1	0.69
11994		6-12	2.9	-0.01	72.6	<0.01	<0.01	<0.01	-0.01	72.6	11.6	0.88
11995		12-24	2.0	-0.01	52.8	<0.01	<0.01	<0.01	-0.01	52.8	32.2	0.69
11996		24-36	2.4	-0.01	26.5	<0.01	<0.01	<0.01	-0.01	26.5	36.8	0.64
11997		36-48	4.7	-0.01	13.6	<0.01	<0.01	<0.01	-0.01	13.6	89.0	0.77
11998	M-7	0-6	2.6	-0.01	95.2	<0.01	<0.01	<0.01	-0.01	95.2	3.23	0.86
11999		6-12	1.3	-0.01	104.	<0.01	<0.01	<0.01	-0.01	104.	12.0	0.81
12000		12-18	3.9	-0.01	78.0	<0.01	<0.01	<0.01	-0.01	78.0	10.5	0.45
12001		18-24	0.6	-0.01	73.3	<0.01	<0.01	<0.01	-0.01	73.3	8.49	0.36
12002		24-30	0.1	-0.01	52.9	<0.01	<0.01	<0.01	-0.01	52.9	7.33	0.25
12003		30-36	0.8	-0.01	65.6	<0.01	<0.01	<0.01	-0.01	65.6	6.92	0.38
12004		36-48	0.4	-0.01	67.4	<0.01	<0.01	<0.01	-0.01	67.4	6.92	0.33
12005	U-7	0-6	4.6	0.24	83.1	<0.01	0.03	0.21	0.94	82.2	1.21	1.80
12005A		6-12	2.5	0.02	49.2	<0.01	0.01	0.01	0.31	48.9	1.58	1.64
12006		12-18	0.4	-0.01	60.8	<0.01	<0.01	<0.01	-0.01	60.8	1.53	1.05
12007		18-24	1.3	-0.01	59.2	<0.01	<0.01	<0.01	-0.01	59.2	1.39	1.24
12008		24-30	0.2	0.01	55.9	0.01	<0.01	<0.01	-0.01	55.9	1.62	0.94
12009		30-36	1.1	-0.01	70.2	<0.01	<0.01	<0.01	-0.01	70.2	1.53	1.12
12010		36-48	<0.1	-0.01	55.9	<0.01	<0.01	<0.01	-0.01	55.9	1.26	0.97

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L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample site S-7

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

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2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	Avail Na meq/100g	Exch Na meq/100g	CEC meq/100g	ESP	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
11993	L-7	0-6	0.44	0.35			1.50	0.1	13.7	7.2	<0.02	0.10
11994		6-12	1.09	0.70			1.90	0.1	16.2	9.9	<0.02	0.08
11995		12-24	0.91	0.54			1.76	0.1	15.6	9.2	<0.02	0.09
11996		24-36	0.52	0.29			1.70	0.1	14.5	8.0	<0.02	0.10
11997		36-48	0.44	0.34			1.50	0.1	15.2	8.2	<0.02	0.13
11998	M-7	0-6	0.83	0.25			1.60	0.1	14.5	8.6	<0.02	0.08
11999		6-12	0.91	0.36			2.00	0.1	14.9	9.1	<0.02	0.07
12000		12-18	0.61	0.43			1.80	<0.1	11.6	6.7	<0.02	0.06
12001		18-24	0.30	0.24					10.1	5.7	<0.02	0.05
12002		24-30	0.22	0.17			1.50	<0.1	10.6	6.0	<0.02	0.04
12003		30-36	0.22	0.19			1.50	0.1	13.3	7.8	<0.02	0.04
12004		36-48	0.30	0.26			1.60	<0.1	12.1	7.1	<0.02	0.04
12005	U-7	0-6	14.9	4.80	11.8	40.5	1.70	0.1	13.2	7.8	<0.02	0.49
12005A		6-12	20.8	5.61	13.6	41.3	1.90	0.1	13.5	7.3	<0.02	0.09
12006		12-18	33.9	9.53	9.14	104.	1.70	0.1	11.9	6.1	<0.02	0.03
12007		18-24	31.8	8.49	10.2	83.4	1.60	0.1	12.4	6.1	<0.02	0.03
12008		24-30	31.1	7.62	11.7	64.9	1.80	0.1	12.3	6.1	<0.02	0.03
12009		30-36	37.2	10.7	8.70	123.	1.60	<0.1	12.7	6.3	<0.02	0.03
12010		36-48	41.5	12.9	6.36	203.	1.80	0.1	11.6	5.8	<0.02	0.03

L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample S-7

* Air dry bulk density was substituted for 1/3 bar bulk density in calculations.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, ABPTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

Miscellaneous abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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Appendix 8

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
12008		24-30	7.7	81.8	29.6	10.2	3.73	794.	301.	35.7	63.2	27.3	9.5	SANDY LOAM
12012	12008(DUP)	24-30	7.8	73.4	28.8	10.0	3.71	746.	285.		63.2	27.3	9.5	SANDY LOAM
12009		30-36	7.7	85.1	29.3	10.8	3.72	904.	336.	32.1	65.5	25.0	9.5	SANDY LOAM
12013	12009(DUP)	30-36	7.7	89.9	30.3	10.9	3.76	870.	321.		63.2	26.8	10.0	SANDY LOAM

L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample S-7

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Appendix 8

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

imL

Inter-Mountain Laboratories, Inc.

2506 West Main Street Farmington, New Mexico 87401 Tel. (505) 326-4737

AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	Organic Carbon %	Total Sulfur %	Neut. Pot. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	Nitrate-Nitrogen ppm	Boron ppm
12008		24-30	0.2	0.01	55.9	0.01	<0.01	<0.01	-0.01	55.9	1.62	0.94
12012	12008(DUP)	24-30	0.2	-0.01	53.0	<0.01	<0.01	<0.01	-0.01	53.0	1.61	0.92
12009		30-36	1.1	-0.01	70.2	<0.01	<0.01	<0.01	-0.01	70.2	1.53	1.12
12013	12009(DUP)	30-36	1.5	-0.01	69.1	<0.01	<0.01	<0.01	-0.01	69.1	1.46	1.14

L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample S-7

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Appendix 8

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut= Neutralization Potential

imL

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AMAX COAL COMPANY
EVANSVILLE, INDIANA
MINE: CASTLE GATE
Sowbelly Canyon

DATE REPORTED: June 5, 1991

Lab No.	Location	Depths	Avail Na meq/100g	Exch Na meq/100g	CEC meq/100g	ESP	Bulk Density *	Water Retention Difference in/in*	1/3 bar	15 bar	H2O Sol Selenium ppm	Total Kjeldahl Nitrogen %
12008		24-30	31.1	7.62	11.7	64.9	1.80	0.1	12.3	6.1	<0.02	0.03
12012	12008(DUP)	24-30	33.9	12.4	10.2	122.			12.5	6.2	<0.02	0.03
12009		30-36	37.2	10.7	8.70	123.	1.60	<0.1	12.7	6.3	<0.02	0.03
12013	12009(DUP)	30-36	36.2	9.80	13.5	72.7			13.1	6.3	<0.02	0.03

L-7= Lower sample site 30' upstream from original sample S-7
M-7= Original sample site S-7 (resampled)
U-7= Upper sample site 30' downstream from original sample S-7

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Appendix 8

* Air dry bulk density was substituted for 1/3 bar bulk density in calculations.
Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, ABPTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

CHAPTER 9
VEGETATION

CASTLE GATE MINE
AMAX COAL COMPANY
Carbon County, Utah

April 1995

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CHAPTER 9

VEGETATION

R645-301-300-320-321 Natural Resources; Oil, Gas and Mining; Coal. Coal Mine Permitting: Permit Application Requirements.

9.1 - 9.3 VEGETATION INFORMATION

The baseline vegetation inventory conducted by Mariah Associates is included as Appendix 9-1 to this chapter.

9.4 RECLAMATION PLAN

The revegetation plan for the permit area is presented in this chapter by repeating and then addressing the relevant regulations specified by the Utah Division of Oil, Gas, and Mining.

9.4-1 Revegetation

Each application will contain a reclamation plan for final revegetation of all lands disturbed by coal mining and reclamation operations, except water areas and the surface of roads approved as part of the postmining land use, as required in R645-301-353 through R645-301-357, showing how the applicant will comply with the biological protection performance standards of the State Program.

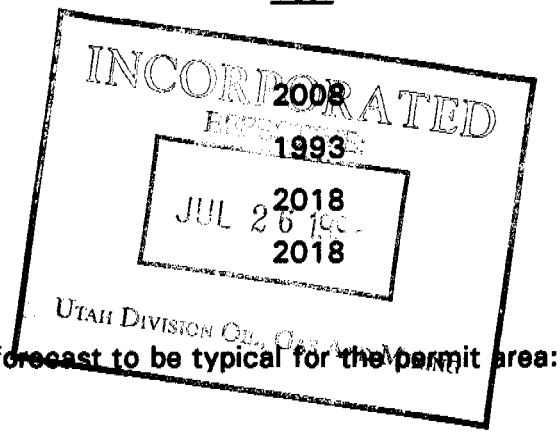
The purpose of the revegetation plan is to ensure the re-establishment of the postmining land use. As discussed in Chapter 4, the postmining lands uses for the permit area are grazing and wildlife.

9.4-1(1) Revegetation Timetable

A detailed schedule and timetable for the completion of each major step in the revegetation plan;

The following timetable for revegetation is forecast for the permit area:

Location	Year
Hardscrabble Canyon	2008
Sowbelly Canyon	1993
Crandall Canyon	2018
Castle Gate	2018



The following schedule for revegetation is forecast to be typical for the permit area:

- perform regrading and create microtopographic features
- prepare seedbed
- fertilize, if scheduled at this time
- seed by drill, hydroseeder, or broadcast
- mulch, if scheduled at this time
- fertilize, if scheduled at this time
- perform husbandry practices as appropriate
- perform monitoring activities
- request release from bond

9.4-1(2) Seed and/or Seedling Mix

Species and amounts per acre of seeds and/or seedlings to be used. If fish and wildlife habitat will be a postmining land use, the criteria of R645-301-342.300 apply.

As specified by regulation and further addressed below, two types of revegetation will be conducted on the permit area: revegetation of previously mined areas (including highwall and cut slope areas), and revegetation of areas mined or disturbed by mining-related activities since May 1978 (SMCRA Areas). The locations of previously mined areas are shown Maps 3.2-1, 3.3-1, 3.4-1, 3.5-1, 3.6-1, and 3.7-1. Special areas for wildlife in both SMCRA and previously mined areas will also be planted in accordance with the mixtures and techniques specified below.

The species mixture for previously mined areas is modelled upon a mixture used successfully by the DOGM to revegetate local abandoned mined lands. This mixture is given in Species List #1. This mixture will also be used to revegetate drill holes and sites of less than one acre.

SMCRA areas will be revegetated with the mixture presented in Species List #2 and #3, where appropriate. North-facing slopes will receive transplants.

Wildlife areas will be revegetated, where appropriate, with the mixtures presented in Species Lists #2 and #3. Species List #4 will be used for temporary stabilization. Shrubs for wildlife may be planted from seed or by transplanting. Riparian Species Mix No. 5 will be used to seed the areas within 20 feet of the edge of reclamation channels.

When the species shown in the Species Lists are not available for planting, substitution of an equivalent native species will be made and reported to DOGM.

SPECIES LIST #1

SPECIES	# pls/acre
Agropyron smithii Western wheatgrass	3.0
Agropyron spicatum Bluebunch wheatgrass	2.0
Amelanchier utahensis Utah Serviceberry	1.0
Artemisia ludoviciana Louisiana sagebrush	0.1

SPECIES LIST #1 (Continued)

SPECIES	# pls/acre
Artemisia tridentata vaseyana Mountain big sagebrush	0.2
Aster glaucodes Blueleaf Aster	0.5
Atriplex canescens Fourwing saltbush	3.0
Ceratoides lanata Winterfat	1.5
Cercocarpus ledifolius Curl-leaf mountain mahogany	1.0
Chrysothamnus nauseosus albicaulis Whitestem rubber rabbitbrush	0.5
Elymus cinereus Basin wildrye	2.0
Agropyron dasystachyum Thickspike wheatgrass	2.0
Linum lewisii False flax	1.0
Melilotus officinalis Yellow sweetclover	0.5
Oryzopsis hymenoides Indian Ricegrass	2.0
Penstemon palmeri Palmer Penstemon	0.2
Petalostemum purpureum Purple prairie clover	0.5
Poa ampla Bluegrass	0.2
Rhus trilobata Skunkbrush	1.5
Sporobolus cryptandrus Sand dropseed	0.1
Total Seed	22.8

SPECIES LIST # 2

SPECIES	# pls/acre
Agropyron smithii Western wheatgrass	3.0
Agropyron spicatum Bluebunch wheatgrass	2.0
Agropyron trachycaulum Slender wheatgrass	2.0
Amelanchier sp.* Serviceberry	1.0
Artemisia ludoviciana Louisiana sagebrush	0.1
Artemisia tridentata vaseyana Mountain big sagebrush	0.1
Bromus marginatus Mountain brome	4.0
Cercocarpus ledifolius Curl-leaf mountain mahogany	1.0
Chrysothamnus nauseosus Rubber rabbitbrush	1.0
Linum lewisii False flax	1.0
Melilotus officinalis Yellow sweetclover	0.5
Penstemon sp. Penstemon	0.3
Poa sp.* Bluegrass	0.3
Purshia tridentata Bitterbrush	3.0
Symphoricarpos oreophilus Mountain snowberry	1.0
Total Seed	20.3

* species selected will be found in the region

SPECIES LIST # 3

SPECIES	# pls/acre
Achillea millefolium Yarrow	0.5
Agropyron riparium Streambank wheatgrass	3.0
Agropyron trachycaulum Slender wheatgrass	3.0
Bromus marginatus Mountain brome	4.0
Elymus cinereus Great Basin wildrye	3.0
Aster glaucodes Blueleaf Aster	0.5
Lupinus sp.* Lupine	2.0
Melilotus officinalis Yellow sweetclover	1.0
Petalostemum purpureum Purple prairie clover	0.5
Poa sp.* Bluegrass	0.2
Total Seed	17.7

TRANSPLANTS	Seedlings/acre
Amelanchier sp.* Serviceberry	50
Cornus stolonifera Red-osier dogwood	100
Populus sp.* Cottonwood	100
Prunus virginiana Chokecherry	50
Rosa sp.* Rose	100
Salix sp.* Willows	500
Total Seedlings	900

* species selected will be found in the region

SPECIES LIST # 4

SPECIES	# pls/acre
Agropyron cristatum Crested wheatgrass	3.0
Agropyron dasystachyum Thickspike wheatgrass	3.0
Agropyron smithii Western wheatgrass	3.0
Agropyron trichophorum Pubescent wheatgrass	4.0
Elymus junceus Russian wild rye	3.0
Oryzopsis hymenoides Indian ricegrass	3.0
Annual grain Oats, spring wheat, or barley	12 - 30
Total Seed	31 - 49

* species selected will be found in the region.

SPECIES LIST # 5

SPECIES	# pls/acre
Achillea millefolium Yarrow	0.5
Agropyron riparium Streambank wheatgrass	3.0
Agropyron trachycaulum Slender wheatgrass	3.0
Bromus marginatus Mountain brome	4.0
Elymus cinereus Great Basin wildrye	3.0
Aster glaucodes Blueleaf Aster	0.5
Lupinus sp.* Lupine	2.0
Melilotus officinalis Yellow sweetclover	1.0
Petalostemum purpureum Purple prairie clover	0.5
Poa sp.* Bluegrass	0.2
Total Seed	17.7

TRANSPLANTS	Seedlings/acre
Amelanchier sp.* Serviceberry	50
Populus sp.* (optional) Cottonwood	
Prunus virginiana Chokecherry	200
Rosa sp.* Rose	100
Salix sp.* (optional) Willows	

SPECIES LIST # 5 (Continued)

TRANSPLANTS	Seedlings/acre
Sambucus Coerulea Elderberry	100
Cercocarpus ledifolius Curl-leaf mountain mahogany	50
Total Seedlings	500

* species selected will be found in the region

9.4-1(3) Seeding Methods

Methods to be used in planting and seeding;

Fertilizer, if needed, will be broadcast prior to seeding, applied with the hydroseeder, or broadcast following plant establishment, depending on the condition of the growth medium and the success of establishment. Seed and fertilizer will not be mixed together in the hydroseeding slurry.

Seed will be applied with a drill, either of the standard or Brillion type, by hydroseeder, or by broadcasting. When applied by hydroseeder or by broadcasting, seed amounts will be double those recommended in the planting lists. Where a drill is to be used, a broadcast seeder will be attached to the drill or broadcast methods will be used to ensure separate shallow seeding of small seeds and fluffy or trashy seeds.

9.4-1(4) Mulching Techniques

Mulching techniques, including type of mulch and rate of application;

Following seeding, seeded areas will be mulched, or other soil stabilizing practices will be used, to ensure the establishment of vegetation in accordance with performance standards.

Tub mulching followed by crimping will be used where areas are accessible to such equipment. Native hay or straw mulch will be applied at a rate of no less than two tons per acre. Crimping will occur along the contour.

Where tub mulching is not practical, or where hydroseeding is the method of seed application, hydromulching with wood fiber, paper fiber, or a wood/paper fiber mixture at a rate of 2000 per acre will follow seeding. Tackifier will be included with the mulch.

Where synthetic mulches promise superior performance, such mulches may be used in place of hay, straw, or fiber mulches. Synthetic mulches will be approved prior to use by DOGM.

Areas inaccessible to hydromulching will be mulched with straw or other appropriate material and tacked with nylon netting. Fiber matting or geosynthetics may be used in place of mulch and nylon net in such inaccessible areas.

9.4-1(5) Irrigation and Pest Control

Irrigation, if appropriate, and pest and disease control measures, if any; and

No irrigation is planned. However, transplants will be watered on a case-by-case basis to minimize drought kill. No pest or disease control measures are anticipated to be necessary. Should such control become necessary, a plan will be developed in consultation with Carbon County Weed and Pest and reported in the annual report. Approval for pest and disease control measures will be obtained from DOGM prior to implementation of the program.

9.4-1(6) Success of Revegetation

Measures proposed to be used to determine the success of revegetation as required in R645-301-356.

Revegetation success measures are discussed below in the section entitled "Performance Standards".

9.4-2 Fish and Wildlife

Each application will contain a fish and wildlife plan for the reclamation and postmining phase of operation consistent with R645-301-330, the performance standards of R645-301-358, and include the following:

9.4-2(1) Wildlife Enhancement Measures

Enhancement measures that will be used during the reclamation and postmining phase of operations to develop aquatic and terrestrial habitat. Such measures may include restoration of streams and other wetlands, retention of ponds and impoundments, establishment of vegetation for wildlife food and cover, and the replacement of perches and nest boxes. Where the plan does not include enhancement measures, a statement will be given explaining why enhancement is not practicable.

Wildlife enhancement will be created by the development of micro-topographic features such as swales and rises created during regrading; by the establishment of rockpiles, where rocks become available during regrading; and by the use of the species specified above. Regrading activities and habitat construction for each reclaimed area are presented in Chapter 3.

Where natural materials are available for the creation of snags and roosts, such snags and roosts will be constructed. Wetland areas will be created wherever topography and hydrology lend themselves to their creation.

9.4-2(2) Fish and Wildlife Habitat

Where fish and wildlife habitat is to be a postmining land use, the plant species to be used on reclaimed areas will be selected on the basis of the following criteria:

Their proven nutritional value for fish or wildlife.

Their use as cover for fish or wildlife; and

Their ability to support and enhance fish or wildlife habitat after the release of performance bonds. The selected plants will be grouped and distributed in a manner which optimizes edge effect, cover, and other benefits to fish and wildlife.

The species mixtures specified in this chapter meet the requirements of 342.200 through 230.

9.5 PERFORMANCE STANDARDS

9.5-1 General Requirements

All coal mining and reclamation operations will be carried out according to plans provided under R645-301-330 through R645-301-340.

The activities specified in this chapter will be conducted in accordance with this general requirement.

9.5-2 Contemporaneous Reclamation

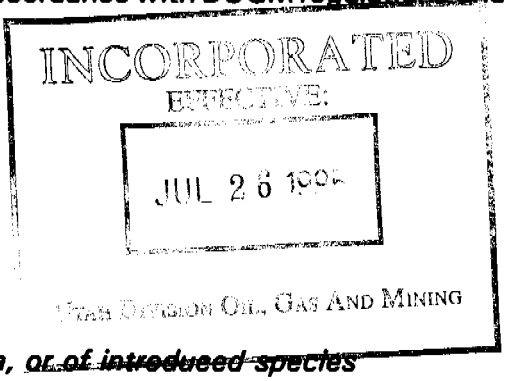
Revegetation on all land that is disturbed by coal mining and reclamation operations, will occur as contemporaneously as practicable with mining operations, except when such mining operations are conducted in accordance with a variance for combined surface and underground coal mining and reclamation activities issued under R645-302-280. The Division may establish schedules that define contemporaneous reclamation.

Revegetation activities will occur as contemporaneously as possible with the mining operation.

9.5-3 Revegetation General Requirements

The permittee will establish on regraded areas and on all other disturbed areas, except water areas and surface areas of roads that are approved as part of the postmining land use, a vegetative cover that is in accordance with the approved permit and reclamation plan.

Vegetative cover will be established in accordance with DOGM regulations and the plan presented in this chapter.



9.5-3(1) Vegetative Cover

The vegetative cover will be:

Diverse, effective, and permanent;

Comprised of species native to the area, ~~or of introduced species~~ where desirable and necessary to achieve the approved postmining land use and approved by the division; at least equal in extent of cover to the natural vegetation of the area; and capable of stabilizing the soil surface from erosion.

The reestablished plan species will:

Be compatible with the approved postmining land use;

Have the same seasonal characteristics of growth as the original vegetation;

be capable of self-regeneration and plant succession;

Be compatible with the plant and animal species of the area; and

meet the requirements of applicable utah and federal seed, poisonous and noxious plant; and introduced species laws or regulations.

The species presented in Species Lists #2 and #3 will meet the requirements of 353.100-250 above for SMCRA areas. Revegetation of previously mined areas will meet the regulatory standard for such areas.

The Motyka Index will be used as the index of comparison for diversity, seasonal characteristics, permanence, and utility for the postmining land use between reclaimed and reference areas. The following life-form categories will be used:

Non-weedy Shrub Cover
Weedy Shrub Cover
Native Perennial Grass Cover

Introduced Perennial Grass Cover
Non-weedy Forb Cover
Weedy Forbs and Grass Cover

Weeds are those species identified as weeds by the Carbon County Weed and Pest at the time the comparison between the reclaimed and reference areas is being made.

Absolute cover will be used to compute the Motyka index. The index standard for comparison between the reclaimed and reference areas will be the percent similarity calculated between samples within the reference area, or 70 percent, whichever is less, unless otherwise approved by DOGM.

9.5-3(2) Revegetation Exception

The Division may grant exception to the requirements of R645-301-353.220 and R645-301-353.230 when the species are necessary to achieve a quick-growing, temporary, stabilizing cover, and measures to establish permanent vegetation are included in the approved permit and reclamation plan.

No exceptions are requested.

9.5-4 Revegetation Timing

Disturbed areas will be planted during the first normal period for favorable planting conditions after replacement of the plant-growth medium. The normal period for favorable planting is that planting time generally accepted locally for the type of plant materials selected.

Planting will typically occur after 15 October and before ground freeze-up. When necessary, spring planting will occur after 15 March but before 15 May. Drainages will be

planted in mid-April, when possible. Unusual favorable meteorological conditions or compliance requirements may result in planting efforts at times different from those specified.

9.5-5 Mulching and Stabilizing Practices

Suitable mulch and other soil stabilizing practices will be used on all areas that have been regraded and covered by topsoil or topsoil substitutes. The Division may waive this requirement if seasonal, soil, or slope factors result in a condition where mulch and other soil stabilizing practices are not necessary to control erosion and to promptly establish an effective vegetative cover.

Mulching will be conducted in accordance with the plan specified in this chapter. Soil stabilization will occur in accordance with the plan specified in Chapter 8.

9.5-6 Revegetation Standards for Success

Success of revegetation will be judged on the effectiveness of the vegetation for the approved postmining land use, the extent of cover compared to the extent of cover of the reference area or other approved success standard, and the general requirements of R645-301-353.

Standards for success, statistically valid sampling techniques for measuring success, and approved methods are identified in the Division's "Vegetation Information Guidelines, Appendix A."

Standards for success will include criteria representative of unmined lands in the area being reclaimed to evaluate the appropriate vegetation parameters of ground cover, production, or stocking. Ground cover, production, or stocking will be considered equal to the approved success standard when they are not less than 90 percent of the success standard. The

sampling techniques for measuring success will use a 90-percent statistical confidence interval (i,e., one-sided test with a 0.10 alpha error).

9.5-6(1) Postmining Land Use

Standards for success will be applied in accordance with the approved postmining land use and, at a minimum, the following conditions:

For areas developed for use as grazing land or pasture land, the ground cover and production of living plants on the revegetated area will be at least equal to that of a reference area or such other success standards approved by the Division.

For areas to be developed for fish and wildlife habitat, recreation, shelter belts, or forest products, success of vegetation will be determined on the basis of tree and shrub stocking and vegetative ground cover. Such parameters are described as follows:

Minimum stocking and planting arrangements will be specified by the Division on the basis of local and regional conditions and after consultation with and approval by Utah agencies responsible for the administration of forestry and wildlife programs. Consultation and approval may be on a program-wide basis or on a permit-specific basis.

Trees and shrubs that will be used in determining the success of stocking and the adequacy of plant arrangement will have utility for the approved postmining land use. At the time of bond release, such trees and shrubs will be healthy, and at least 80 percent will have been in place for at least 60 percent of the applicable minimum period of responsibility. No trees and shrubs in place for less than two growing seasons will be counted in determining stocking adequacy.

Vegetative ground cover will not be less than that required to achieve the approved postmining land use.

Revegetation success for SMCRA AREAS will be measured in accordance with 356.100 through 233 as stated above. Reference areas for SMCRA areas such as Crandall Canyon are identified in the specific sections giving the reclamation plans for those areas.

9.5-6(2) Previously Disturbed Areas

For areas previously disturbed by mining that were not reclaimed to the requirements of R645-200 through R645-203 and R645-301 through R645-302 and that are remined or otherwise redisturbed by coal mining and reclamation operations, at a minimum, the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion.

Revegetation success for previously mined areas will be measured in accordance with 356.250 as stated above. The AML Reference Areas shown on Exhibit 9-6 will be used to evaluate previously mined areas. Revegetation will be evaluated in accordance with 356.100 through 210 as stated above.

While some erosion is natural as part of a functioning hydrogeomorphologic system, erosion will be controlled if it becomes, or threatens to become, disruptive of the postmining land use or inconsistent with erosional activities typical of the local area. Suitable measures of erosion will be established in consultation with the Division of Oil, Gas and Mining, and such measures will be employed upon approval by that agency. Until suitable measures of erosion are established, areas of active erosion and their remediation will be evaluated with the agency on a case-by-case basis.

9.5-7 Extended Responsibility Period

The period of extended responsibility or successful vegetation will begin after the last year of augmented seeding, fertilization, irrigation, or other work, excluding husbandry practices that are approved by the Division in accordance with paragraph R645-301-357-300.

The period of extended responsibility, also called the "bonding period" will begin as required by 357.100 as stated above. Initiation of the bonding period for a revegetated area will be reported in the annual report.

9.5-7(1) Vegetation Parameters

Vegetation parameters identified in R645-301-356.200 will equal or exceed the approved success standard during the growing seasons for the last two years of the responsibility period. The period of extended responsibility will continue for five or ten years based on precipitation data reported pursuant to R645-301-724.411, as follows:

In areas of 26.0 inches or less average annual precipitation, the period of responsibility will continue for a period of not less than ten full years;

Prior to seeking bond release, SMCRA areas will be shown to meet the requirements of 357.200 and 357.220 as stated above. Previously mined areas will be shown to meet the standards of 356.250 as stated above.

9.5-7(2) Husbandry Practices

The Division may approve selective husbandry practices, such as weed and brush control, fencing, and water developments or other practices once they have been incorporated into

the Utah program, in accordance with 30 CFR 732.17 as being normal husbandry practices, excluding augmented seeding, fertilization, or irrigation, without extending the period of responsibility for revegetation success and bond liability, if such practices can be expected to continue as part of the postmining land use or if discontinuance of the practices after the liability period expires will not reduce the probability of permanent revegetation success. Approved practices will be normal conservation practices within the region for unmined lands having land uses similar to the approved postmining land use of the disturbed area, including such practices as disease, pest, and vermin control; and any pruning, reseeding and/or transplanting specifically necessitated by such actions.

Conservation practices normal to the area, including weed and brush control, fencing, water development and interseeding may be used to help ensure success on revegetated areas. Pruning, reseeding, and/or transplanting will be used in accordance with the requirements of 357.300 as stated above.

9.5-8 Protection of Fish, Wildlife, and Related Environmental Values

The operator will, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts on fish, wildlife, and related environmental values and will achieve enhancement of such resources where practicable.

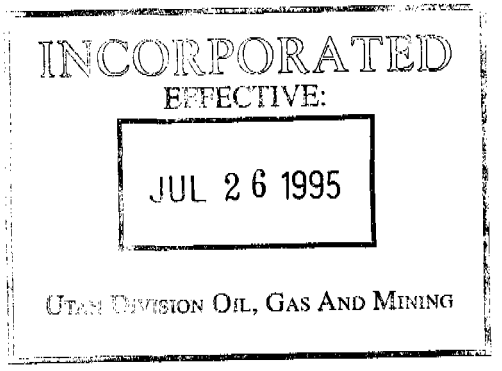
The operator conducting coal mining and reclamation operations will avoid disturbances to, enhance where practicable, restore, or replace, wetlands and riparian vegetation along rivers and streams and bordering ponds and lakes. Coal mining and reclamation operations will avoid disturbances to, enhance where practicable, or restore, habitats of unusually high value for fish and wildlife.

The techniques specified in this chapter will be employed to meet the requirements of 358.400 as stated above.

Each operator will, to the extent possible using the best technology currently available:

Fence, cover, or use other appropriate methods to exclude wildlife from ponds which contain hazardous concentrations of toxic-forming materials.

Fencing or covering will be used where necessary to exclude wildlife from ponds that contain hazardous concentrations of toxic-forming materials.



APPENDIX 9-1

MARIAH ASSOCIATES BASELINE INVENTORY

VEGETATION DATA REPORT
FOR
PRICE RIVER COAL COMPANY'S MINE AREA
HELPER, UTAH

Prepared For

Price River Coal Company
Helper, Utah

By

Mariah Associates
Laramie, Wyoming

November 1981

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1.0 INTRODUCTION

Mariah Associates conducted vegetation studies during the 1981 growing season on Price River Coal Company's Mine Plan Area around Helper, Carbon County, Utah (Figure 1.1). The mine plan area consisted of approximately 42 square miles in all or parts of Sections 35-36, T12S R8E; 25-36 T 12S R9E; 26-35 T12S R10E; 2 T13S R8E; 1-6, 8-12, 14, 16, 17, T13S R9E; 1-6, 8-12, 15-18, 20-22, 28-30, T13S R10E (Map 1, Appendix B).

Price River Coal Company (PRCC) has several facilities currently in operation or under construction within the mine plan area for which reference area were established. In addition, vegetation baseline studies for an area in Barn Canyon that may be disturbed by future activities were conducted. The objectives of the study were to:

- Establish reference areas for vegetation types that had been present prior to mining to serve as benchmarks for evaluating reclamation success.

- Measure selected parameters that would provide information on existing vegetation conditions on reference areas and the potentially affected area in Barn Canyon.

- Identify any threatened or endangered plant species protected by federal or state laws.

Vegetation parameters measured were species composition, cover, frequency, shrub density, shrub height, tree density, and basal area. Estimates of vegetation productivity were obtained from the Soil Conservation Service (Appendix A).

All methods used for the study area are described in this report. Results are summarized in tabular form and discussed in the text of the

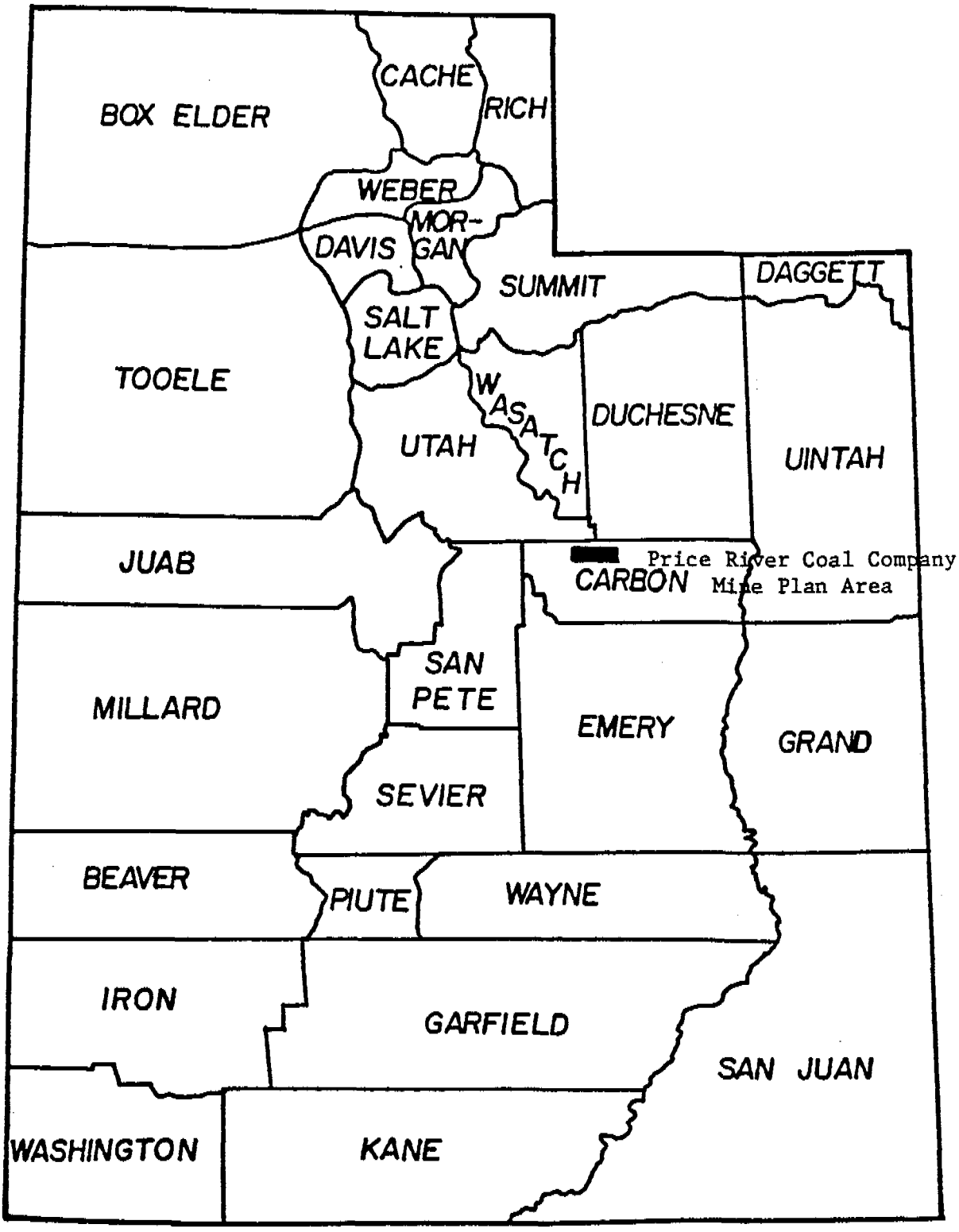

Figure 1.1 Mine Plan Area Location

report. Vegetation types, reference areas, and sample site locations are shown on Maps (Appendix B). Computer listings of all field and analyzed data are presented for each area sampled (Appendix C). Lists of vegetation species encountered on each of the vegetation types are also included (Appendix C).

2.0 METHODS

The study was patterned after Utah Divison of Oil, Gas, and Mining (UDOGM) Preliminary Guidelines for Vegetation Studies on Coal Mines (June 6, 1980 revision). Specific study requirements and techniques were defined during consultations with personnel from UDOGM (Mary Ann Wright, Reclamation Biologist and Administrator of Abandoned Mine Reclamation; Susan Linner, Reclamation Biologist; Lynn Kunzler, Reclamation Biologist), and Office of Surface Mining (OSM) (Larry Larson, Vegetation Specialist). Wyoming Department of Environmental Quality (WDEQ) Guideline #2 "Vegetation", January 1981, was used for supplemental information on data analysis techniques.

A field reconnaissance was performed in June 1981 to determine the boundaries of the mine plan areas, the number of vegetation types and identify potential reference areas. Disturbed areas associated with this underground mine include portals, loadout, waste disposal, and other surface facilities such as tanks, equipment, roads, and materials storage. Construction of a shaft and associated facilities is presently taking place in Crandall Canyon. Most disturbed areas are located in the bottoms of canyons. An area in Barn Canyon may be used for a waste disposal site in the future.

Vegetation studies necessary to meet regulatory requirements were preparation of a vegetation cover map for the mine plan area, selection of reference areas for vegetation types that existed in the disturbed areas prior to mining, selection of reference areas for vegetation types that occur in the affected area of Barn Canyon, and sampling of the affected area and the reference sites to describe vegetation species composition and cover. This reference area approach does not require sampling of vegetatin production until studies to ascertain success of reclamation are conducted. Estimates of vegetation production for the various reference areas as well as the affected area in Barn Canyon were obtained from the Soil Conservation Service (SCS) (Appendix A).

The folowing procedures were used to provide vegetation data for the project:

- Map and describe all major vegetation communities within the mine plan area
- Ascertain vegetation types that occurred in disturbed aras prior to mining activity and select reference areas to represent the various types
- Ascertain vegetation types that occur in the Barn Canyon affected area, select sampling points in the affected area, and select reference areas to represent the affected area vegetation types.
- Ascertain species composition and prepare voucher collection
- Estimate vegetation cover
- Estimate shrub density and shrub heights
- Estimate tree density and basal area
- Obtain estimates of productivity from the SCS
- Photograph all vegetation types

All procedures are explained below.

2.1 MAPPING

A thorough reconnaissance was conducted in June 1981 to identify plant communities within the permit area for a preliminary vegetation map. The distribution of vegetation types on the mine permit area was delineated on clear acetate sheets overlaying black and white aerial photographs. Type

delinations were then transferred to a topographic base map at a scale of 1 in = 1000 ft. Accurate transfer of type delineations was accomplished by aligning topographic and man-made features common to both the aerial photograph and the topographic base map with the aid of zoom transfer equipment. The vegetation map was ground-truthed at numerous points in and near the disturbed, affected, and reference areas. The final topographic base map with all vegetation type delineations was expanded to a scale of 1 in = 400 ft for all disturbed and affected areas and a 1 in = 100 ft map was prepared for the Crandall Canyon Leach Field (the scale of all maps was approved or specifically requested by UDOGM personnel, Lynn Kunzler, Reclamation, Biologist). Locations of each reference area on the mine permit area were plotted on the topographic maps. Sample site locations in the Barn Canyon affected area were also plotted on the vegetation map. Mapping units on the mine plan area were: grassland-sagebrush (grass-sage), pinyon-juniper, riparian bottom, mixed brush, conifer, saltbush, pre-1977 mining disturbances, post-1977 mining disturbances, (including areas disturbed by mining prior to 1977 that were subsequently used for mining activity) and other disturbances.

Total acreages of all disturbed areas within the mine plan area, the acreage of the vegetation to be disturbed in Crandall Canyon, and the acreage of potentially affected areas in Barn Canyon were estimated by standard polar planimeter techniques. Each measureable unit was planimetered until three independent measurements were within 10 percent of one another. These three measurements were then averaged to obtain an acreage estimate for the unit. The individual estimates for all units of a specific type were then summed to provide an estimate of the acreage within each type. Percent of each vegetation type in disturbed areas was estimated where the exact location of vegetation type boundaries prior to disturbance could not be determined. This estimate was based on relative distribution of vegetation types on nearby undisturbed areas with similar topography, similar slope, aspect, and soil characteristics.

2.2 SELECT REFERENCE AREAS

Vegetation types that occurred in the disturbed areas prior to mining activity were ascertained by examination of undisturbed areas immediately above, below, and surrounding the disturbed sites as well as other similar sites nearby that have not been disturbed. Aerial photos taken prior to disturbance were also used to help identify pre-disturbance vegetation types.

The primary goal of vegetation studies is to establish valid reference areas which must be utilized to meaure the success of revegetation for the purpose of bond release (UDOGM 1980). Reference areas, approximately 2 to 3 acres in size, were selected for each of the major vegetation types that have been disturbed as well as those types that occur in the potentially affected ara in Barn Canyon. Reference areas were selected on the basis of similarity of species composition, cover, productivity, geology, soils, slope, and aspect with representative vegetation types on the disturbed and affected areas. Reference sites were established in areas not to be disturbed by project activities. Location of the reference sites were marked by steel rods in the field and plotted on the vegetation maps (Appendix B).

On August 14, 1981, UDOGM personnel (Kunzler, Linner, and Wright) toured the proposed reference areas for the sites presently disturbed by mining, except for the grass-sage reference area near Barn Canyon, which was added later. Reference areas for the potentially affected types in Barn Canyon, which were not examined by UDOGM personnel because they were selected subsequent to the tour, were selected with an interative process on the basis of a t-test comparison of vegetative cover to demonstrate equality of the affected and reference areas. The t-test comparison is the least subjective method used to evaluate potential reference areas (Bonham et al. 1980:52). The reference area selection process involved comparison of vegetative cover data from each potentially affected type in Barn Canyon with data from corresponding reference areas for disturbed sites that had

been established for the type. If the t-test comparison indicated that vegetative cover on the affected area and proposed reference area were significantly different, another reference area was selected, sampled, and the data compared to the affected area vegetative cover data. This process was repeated for each type until no significant difference between the affected area and proposed reference area could be demonstrated. Such an approach assured that proposed reference areas would be equivalent for the potentially affected types in Barn Canyon.

2.3 VEGETATION SPECIES COMPOSITION

Reconnaissance-type surveys were conducted within each major vegetation type on the project site to obtain a complete listing of vegetation species for the study area. Specific species composition surveys were conducted by a plant taxonomist during two field trips scheduled to take advantage of different plenological periods in 1981. During the survey, the botanist listed all plants observed during a thorough reconnaissance of each vegetation type. A plant voucher collection was prepared for all plants identified during the study. For each plant collected, date, habitat, elevation, and associated species were recorded. Questionable plant species were taken to the Rocky Mountain Herbarium, Laramie, Wyoming for positive identification. Specific searches for threatened, endangered, noxious weeds, and selenium indicator plant species were conducted in appropriate habitats during the species composition study. Any additional species observed during the vegetation cover sampling were recorded and added to the species list of the appropriate vegetation type.

2.4 SELECTION OF SAMPLE POINTS

All sample points for vegetation cover, shrub, and tree data were randomly selected. On the reference areas, a table of random numbers was used to identify the starting point of each transect as follows: A random number indicated the number of paces across one side of the reference area and a second number indicated the number of paces perpendicular to that

side to the point within the reference area. A third random number was used to select transect direction. Sample points for the Barn Canyon affected area were selected by overlaying a grid (interval = 0.4 in) on the 1 in = 400 ft vegetation map and using a random numbers table to identify grid coordinates for each point. Each point was then located in the field by pacing from recognizable landmarks. Transect direction was randomly selected in the same manner as on the reference areas. These techniques ensured that position of each transect was unbiased.

2.5 VEGETATION COVER

Cover data were obtained at 50 points spaced at 1 m intervals along a transect at each randomly selected sample point. A linear point-frequency frame (Mueller-Dombois and Ellenbert 1974) was used to accurately measure vertical hits on vegetation, litter, and bare ground. Crown or shoot cover was measured by counting only the first interception of the pin with a plant part. Overhead canopy cover was determined by recording the plant species hit when the vertical line of the pin was protected upward above the frame. Where crowns overlap in layered vegetation, the uppermost layer was considered the primary vegetation hit and subsequent hits on lower vegetation were recorded separately.

Data derived by the technique described above provided an index for vegetative, litter-rock, and bare ground cover by identifying the frequency with which each of thse components of total cover was encountered along a given transect. Frequency of occurrence of plant species encountered along each transect was also determined by this technique to provide information regarding the relative distribution of all vegetative species encountered within each sample unit.

All cover data were collected during July 7-10, September 27, and October 7-10, 1981. Data were recorded on field forms developed for computer input. A minimum of 15 transects was sampled in each type or reference area prior to sample adequacy calculations. If necessary, additional cover

transects were sampled in each area until the desired level (± 10% $\bar{x}$ @ 90% confidence) was achieved. The number of cover transects in each sampling area is shown in Table 3.1.

2.6 SHRUB DENSITY AND HEIGHTS

Shrub density and height were estimated along the same transects used for cover data. The height, number, and species of shrubs whose stems arose within 50 cm of either side of the 49 m long transect were recorded. Shrub heights were measured and recorded by the following classes: 1-10 cm, 11-30 cm, 31-50 cm, 51-100 cm, 1-2 m, 2-4 m, and over 4 m. On certain reference areas, it was more efficient to conduct an absolute count of the shrubs within the area of known size. The decision to use an absolute count or shrub density transects was based on the effects of distribution and density of the shrubs on efficiency of total counts relative to sampling. Desired confidence level for shrub density was ± 20% $\bar{x}$ @ 80%.

2.7 TREE DENSITY AND BASAL AREA DATA

The point-quarter technique (Smith 1974) was used to collect tree density and basal area data within tree covered types on the study area. At each sample point, imaginary grid lines were used to divide the area into four quarters. The tree nearest to the point in each quarter was recorded by species, circumference at breast height (in) for those larger than 1 in diameter, and distance from the point (ft) on a standard field data form. On certain areas, an absolute count or photo count of trees was conducted instead of point-quarter sampling for density estimates. Absolute counts involved recording the basal area and number of trees of each species within the reference area of known size. Density of trees on the pinyon-juniper areas was determined by counting individual trees within an area of known size on aerial photos with the aid of a magnifying stereoscope. The relative abundance of each species and figures for basal area calculations in the pinyon-juniper area were provided by the point-quarter samples.

2.8 SOIL CONSERVATION SERVICE (SCS) PRODUCTIVITY ESTIMATES

Productivity estimates for the various areas were obtained from the local SCS range conservationist (George Cook) who examined each site.

2.9 PHOTOGRAPHS

All vegetation types were photographed to provide visual documentation of characteristics.

2.10 PERSONS CONTACTED

A list of people contacted for information during the vegetation study is given in Table 2.1.

2.11 DATA ANALYSIS AND REPORTING

A comprehensive data base management and analysis system on a CYBER 730 computer was used to process vegetation data collected during this study. Data were input via keypunched cards that had been double punched and verified for accuracy. All field data were printed out on computer sheets in legible form and in the appropriate format. Cover data were analyzed first by transect, then all data were summarized to provide results by vegetation type. Data are reported for percent cover of vegetation, litter and rock, and bare ground. Vegetation cover data are reported by vegetative species and life form. Sample adequacy and species diversity calculations are shown for each vegetation type or sample area at the bottom of each print-out. This procedure ensures the careful, accurate documentation of every data analysis step from field collection and recording through summary data analysis thereby providing a logical, legible format of data with which any result and conclusion stated in this report can be easily verified. Formulas for all methods and calculations are given in Table 2.2.

Table 2.1 List of People Contacted for Information During the Vegetation Study on Price River Coal Company's Mine Plan Area, 1981

Mr. Thomas Behling
Carbon County Agriculture Extension Agent
Price, Utah

Mr. George Cook
Range Conservationist
Soil Conservation Service
Price, Utah

Mr. Lynn Kunzler
Reclamation Biologist
Utah Division of Oil, Gas, and Mining
Salt Lake City, Utah

Mr. Larry Larson
Vegetation Specialist
Office of Surface Mining
Denver, Colorado

Ms. Susan Linner
Reclamation Biologist
Utah Division of Oil, Gas, and Mining
Salt Lake City, Utah

Mr. Gary D. Moreau
District Conservationist
Soil Conservation Service
Price, Utah

Ms. Mary Ann Wright
Administrator of Abandoned Mine Reclamation
Utah Division of Oil, Gas, and Mining
Salt Lake City, Utah

Table 2.2 Methods and Formulae Used for Vegetation Data Analysis

---

$$\text{Percent Cover} = \frac{h}{pn} \times 100$$

where: h = number of times the species was hit
n = number of transects sampled
p = number of possible hits on each transect

$$\text{Percent Frequency} = \frac{T}{n} \times 100$$

where: T = number of transects containing the species
n = number of transects sampled

$$\text{Shrub Density/ha} = N \times (204.08)$$

where: N = the number of shrubs counted on the transect
204.08 = conversion factor for density per transect area (49 m^2) to density per hectare (10,000 m^2)

For reference areas on which all shrubs or trees were counted, the number of shrubs or trees was divided by the size of the area (determined by pacing in the field or measuring on aerial photos) to obtain the density estimate.

$$\text{Total Tree Density/ha} = \frac{43,560}{\left(\frac{\Sigma PT}{\Sigma D}\right)2} \times (2.47)$$

where: 43,560 = ft^2/ac
2.47 = ac/ha
Σ PT = sum of the point to tree distances in ft
Σ D = total number of distances measured

Individual species densities are then calculated:

$$\text{Density for Species x} = \text{total density} \times \frac{\Sigma x}{T}$$

where: Σx = number of trees of species x in sample
T = total number of trees of all species in the sample

Table 2.2 (continued)

Basal Area (cm^2) = $(CBH \times 0.404)^2$

where: π = 3.1416
CBH = circumference at breast height in inches
.404 = conversion factor to calculate radius in cm from circumference.

$$\text{Mean } (\bar{x}) = \frac{\Sigma x}{n}$$

where: Σx = sum of values for variable under consideration
n = number of transects or observations sampled

$$\text{Standard Deviation } (s) = \sqrt{\frac{\Sigma \bar{x} - x_i}{n - 1}}$$

where: $\bar{x}$ = mean
x_i = value of variable for sample point i
n = number of sample points

Sample Size Adequacy (Wyoming Department of Environmental Quality Guideline #2):

$$N_{min} = \geq \frac{2 (s\ z)^2}{(d\ \bar{x})^2}$$

where: N_{min} = minimum number of samples
s = sample standard deviation
z = z statistic (see table below)
d = amount of reduction to detect (see table below)
$\bar{x}$ = sample mean

z Statistic and d Table

	z	d
Cover	1.28	0.1
Productivity, grasslands	1.28	0.1
Productivity, shrublands	0.84	0.2
Tree and Shrub Density	0.84	0.2

Table 2.2 (continued)

Confidence Level Achieved: $z_i = \frac{\sqrt{\frac{n(d\ \bar{x})^2}{2}}}{s}$

where: n = number of sample points
z_i = calculated z value used in z table for identifying confidence level achieved (other variables defined in sample size adequacy).

Species Diversity Index (H) = $- \Sigma\ p_i \log_e p_i$

where: p_i = decimal fraction of total individuals belonging to the ith species.

Equality of Affected and Reference Areas: t-test Comparison

Ho: reference area j = affected area i
Ha: reference area j = affected area i

$$t_e = \frac{\bar{x}_j - \bar{x}_i}{\sqrt{s_p^2 \frac{n_j + n_i}{n_j n_i}}}$$

where: t_e = estimated t-value which is compared to tabular t-value
$\bar{x}$ = mean
s^2 = variance
n = sample size
i = affected area data
j = reference area data

$$sp^2 = \frac{m_j + m_i}{n_j + n_i - 2}$$

$$m = (n - 1)\ s^2$$

Similarity index: (Bonham et al. 1980:81):

$$s = \frac{2w}{a + b}$$

where: s = similarity between potential reference area and the inventory unit
a = number of species in area a
b = number of species in area b
w = number of species in common for a and b

References: Pielou (1966), Snedecor and Cochran (1967), Bonham et al. 1980, Larson (1980), Wyoming Department of Environmental Quality (1981).

3.0 RESULTS AND DISCUSSION

Coal mining has been conducted in the Mine Plan Area for over 100 years. Old abandoned mines and the associated refuse disposal, transportation facilities, villages, and houses for the work force are scattered throughout many of the canyons in and near the mine area. Major highways (U.S. 6 and Utah 33) and railroad routes pass through the area. There are also a Utah Power and Light Company Electric Generation Station and a municipal water treatment plant along the Price River in or near the Mine Plan Area. As a result of human activity, most of the land along the Price River and many of the canyon bottoms within the river area have been disturbed in the past or are presently in a disturbed condition. In addition to the native species usually found in the various vegetation types, numerous weeds and cultivated plants that have escaped or been abandoned are found in the Mine Plan Area. Land not presently devoted to uses such as mining and transportation, is used primarily for unmanaged livestock grazing. Mule deer (Odocoileus hemionus) and elk (Cervus elaphus) are the large native herbivores that occur in the area while smaller herbivores such as ground squirrels (Spermophilus spp.), chipmunks (Eutamias spp.) and rabbits (Sylvilagus and Lepus spp.) are abundant in several areas.

3.1 VEGETATION TYPES

Vegetation types on the entire Mine Plan Area are depicted on a 1 in = 1000 ft vegetation cover map presented in Appendix A (Map 1). Areas presently disturbed or which may be disturbed by future mining are also shown on the larger scale maps (Appendix A, Maps 2-5). Acreages of vegetation types, disturbed areas, and potential disturbance in the Mine Plan Area are shown in Table 3.1.

The five major vegetation types on the Mine Plan Area are grass-sage, mixed brush, conifer, pinyon-juniper, and riparian bottom (Plates 3.1-3.5, respectively). A very small area of saltbush type occurs on the southern

Table 3.1 Acreages of Disturbed and Potentially Disturbed Sites in the Mine Plan Area

Area		Acres
D1 - Disturbed by mining prior to 1977		190.8
D2 - Disturbed by mining after 1977		215.0
DS - Other disturbance		361.5
	Total Disturbed	767.3
Potential Disturbance in Barn Canyon:		
Conifer	49.4 (21)[1/]	
Grass-sage	39.7 (21)	
Mixed brush	27.8 (14)	
Pinyon-juniper	84.9 (44)	
Subtotal	192.8	
Potential Additional Disturbance Around Waste Disposal in Small Gulch South of Barn Canyon:		
Conifer	3.0 (11)[1/]	
Mixed brush	12.9 (48)	
Pinyon-juniper	11.0 (41)	
Subtotal	26.9	
	Total Potential Additional Disturbance	219.7
Crandall Canyon Area (already included in D2 above):		
Leach Field Area:		
Grass-sage	1.9 (37)	
Mixed brush	2.6 (51)	
Conifer	0.6 (12)	
Subtotal	5.1	
Shaft Site and Associated Facilities:		
Mixed brush	5.5 (48)	
Conifer	0.5 (4)	
Riparian bottom	5.5 (48)	
Subtotal	11.5	
	Total in Crandall Canyon	16.6

[1/] Percent of type in the area

edge of the Mine Plan Area. Since not all disturbed areas were associated with mining and some of the mining disturbance was prior to the effective date of _____, disturbed sites on the Mine Plan Area were identified according to the following criteria: pre-1977 mining disturbance, post-1977 mining disturbance, (including areas disturbed by mining prior to 1977 that were used for subsequent mining activity) and other disturbance. A description of the major types is presented in this section. Quantitative data for specific reference and affected areas is presented in Section 3.3 and Appendix C.

3.1.1 Grass Sage

The grass-sage vegetation type (Plate 3.1) occurs on steep dry slopes as well as along some of the lower drainages in the Mine Plan Area. Relative cover provided by Artemisia spp. or the graminoid components varies depending on site characteristics. Artemisia is dominant in areas such as along the banks of Willow Creek and shares dominance on sites such as those found on the slopes of Sowbelly Canyon but grasses are often dominant on knolls or the tops of small ridges within the type. The area covered by the grass-sage type in the vicinity of the Castle Gate Preparation Plant appears to have been burned many years ago; a few weathered and charred pinyon or juniper stumps are scattered throughout slopes in that area. The upper end of the small grass-sage area in the vicinity of the proposed leach field in Crandall Canyon is covered with almost pure grass but sagebrush becomes more prevalent in the lower end.

The list of vegetative species occurring on the grass-sage type within the mine plan area is presented in Appendix C. No endangered or threatened plant species (Federal Register, December 15, 1980) was observed in this type. Two noxious weeds (Utah Noxious Weed Act 1958), (Cardaria chalepensis and Centaurea repens, and one selenium indicator, Stanleya pinnata, were found in this type. Twenty-four species listed as weeds by Holmgren and Andersen (1971) were found in this type. Neither of the noxious weeds was abundant or widespread enough to have been encountered along vegetation cover transects in the grass-sage type. Stanleya pinnata was encountered

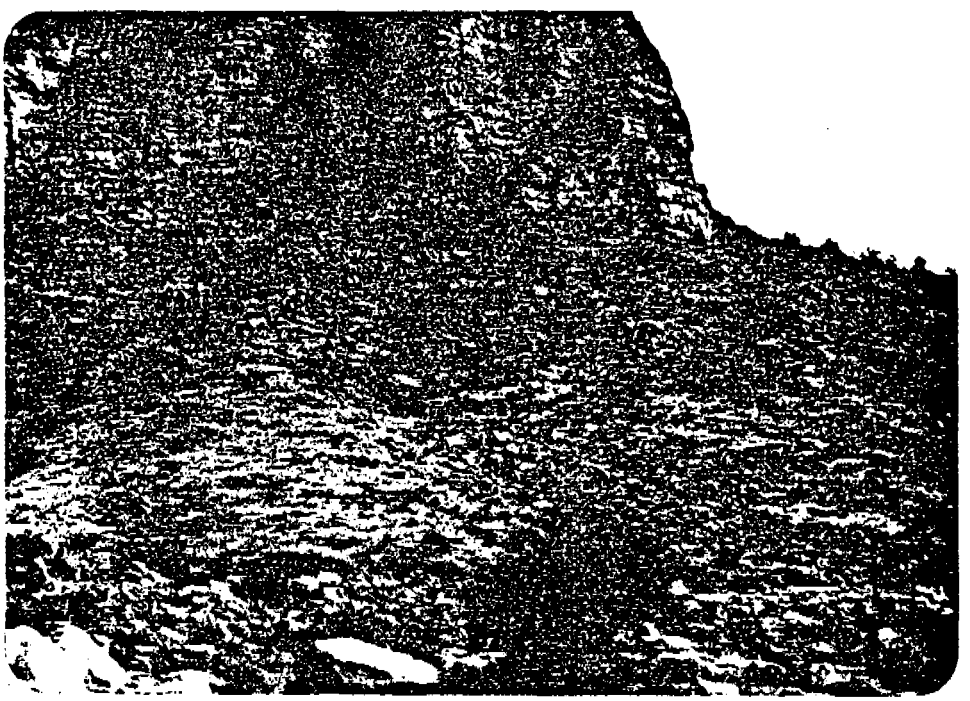

Plate 3.1 Grass-sage vegetation on the Mine Plan Area

once in the Sowbelly grass-sage reference area; it accounted for 0.1 percent of the cover in the area. It was not encountered along transects on any of the other grass-sage areas that were sampled. Bromus tectorum, Chenopodium albium, and Salsola kali were the most widespread common weeds on the grass-sage areas.

3.1.2 Mixed Brush

The mixed brush type (Plate 3.2) generally occurs in relatively moist sites such as the bottoms of gulches and small depressions in the upland areas, however it is found on a wide range of slopes/aspect combinations throughout the study area. Composition of the mixed brush type is highly variable, ranging from dryer sites dominated by Artemisia tridentata, Pinus edulis, Juniperus osteosperma or Amelanchier utahensis, to moist sites dominated by Acer grandiditatum or even Populus tremuloides. The most common species throughout mixed brush type are Quercus gambelii, Symphoricarpos occidentalis, and Artemisia tridentata.

The list of vegetative species occurring within the mixed brush type is presented in Appendix C. No endangered or threatened plant species (Federal Register, December 15, 1980) was observed in this type. Three noxious weeds (Utah Noxious Weed Act 1958), Cardaria chalepensis, Cardeus nutans, and Convolvulus arvensis were found in this type; however, none was widespread or abundant enough to have been encountered on vegetation cover transects in the type. No selenium indicator species was found in the mixed brush type. Twenty-two species listed as weeds by Holmgren and Andersen (1971) were found in this type. Bromus tectorum was encountered on all mixed brush areas in which cover transects were run and Kochia scoparia was encountered on cover transects in the Sowbelly mixed brush reference area.

Plate 3.2 Mixed brush vegetation on the Mine Plan Area

3.1.3 Pinyon-Juniper

Pinyon-juniper vegetation (Plate 3.3) is found on slopes that are steep, rocky, and dry in the northern and central portions of the Mine Plan Area as well as on the more level but equally dry sites below the cliffs in the southern portions of the area. Dominant species in this open, wooded type are Pinus edulus and Juniperus osteosperma. Other common species are Cercocarpus ledifolius, Quercus gambelii, Artemisia tridentata, Chrysothamnus spp., and Agropyron spp. The steepness of the slopes on which this type occurs in much of the mine area precludes grazing by cattle.

The list of species in the pinyon-juniper type is presented in Appendix C. No endangered or threatened species (Federal Register, December 15, 1980) or noxious weed (Utah Noxious Weed Act 1958) was observed in this type. Two selenium indicators, Astragalus flavus and Stanleya pinnata, were found in the pinyon-juniper type; however, they were not widespread or abundant enough to have been encountered on the cover transects. Five species listed as weeds by Holmgren and Andersen (1971) were found in this type.

3.1.4 Riparian Bottom

The riparian bottom type (Plate 3.4) is limited to the streambanks along the Price River and a couple of sites in the bottom of Crandall Canyon. Distinguishing characteristics of this type are the presence of deciduous trees (primarily Populus angustifolia) or relatively open, grass-covered flats in canyon bottoms. Riparian bottoms have been disturbed in the past by overgrazing, human occupation, and periodic flooding and weedy species such as Cynoglossum officinale, Bromus tectorum, Salsola kali, and Convolvulus arvense are common. Senescent Populus angustifolia trees are numerous along Crandall Canyon and seedlings are abundant but there are relatively few saplings.

The list of species occurring in the riparian bottom type is found in Appendix C. No endangered or threatened species (Federal Register,

Plate 3.3 Pinyon-juniper vegetation on the Mine Plan Area

Plate 3.4 Riparian Bottom vegetation on the Mine Plan Area

December 15, 1980) or selenium indicator species was found on this type. Two noxious weeds (Utah Noxious Weed Act 1958), Cirsium arvense and Convolvulus arvensis, occur in the riparian type. Convolvulus arvensis was 3.3 percent of the cover on the Castle Gate riparian area. Cirsium sp. was 0.2 percent of the cover in the Crandall riparian area. Twenty-three species listed as weeds by Holmgren and Andersen (1971) were found in the type. Eight weed species were encountered on transects in the Castle Gate riparian area and four were encountered on transects in the Crandall riparian area.

3.1.5 Conifer

The conifer type (Plate 3.5) is found on the higher elevations, northerly facing slopes, and across some of the drainages in the Mine Plan Area. The type is often dominated by Pseudotsuga menziesii; however, Juniperus osteospermum, Pinus ponderosa, Abies concolor, or Abies lasiocarpa may be more abundant on certain sites. Composition of the understory is influenced by canopy coverage, therefore it varies as the density of trees in the conifer type varies throughout the study area. Relatively dense stands of conifer have relatively little understory of perennial grasses, forbs, and shrubs such as Symphoricarpos occidentalis and Berberis repens. Open stands have relatively more grasses as well as shrubs of the mixed brush type.

The list of vegetative species found in the conifer type is presented in Appendix C. No endangered or threatened species (Federal Register, Cecember 15, 1980) or selenium indicator species was found in this type. One noxious weed (Utah Noxious Weed Act 1958), Onopordum acanthium, was found in the type; however, it was not widespread or abundant enough to have been encountered on the vegetation cover transects. Eleven species listed as weeds by Holmgren and Andersen (1971) were found in this type. The most abundant weeds in the conifer type was Cerastium sp. which was 0.3 percent of the cover on the Crandall conifer area and Taraxacum officinale which was 0.1 percent of the cover in the Crandall area.

Plate 3.5 Conifer vegetation on the Mine Plan Area

3.1.6 Saltbush

An extremely small amount of the saltbush vegetation type (5 acres) occurs on the southern edge of the Mine Plan Area. This type occurs on a clay hillside which is sparsely vegetated by Atriplex cavesens and Sarcobatus vermiculatus as well as other species adopted to the harsh growing conditions. No affected sites or reference areas occur within this area so quantitative studies were not conducted in this minor type.

3.1.7 Disturbed

Sites for mine facilities and associated disturbance, highways, railroads, and other human disturbance are included in this type. Disturbed sites were identified according to whether they were pre-1977 mining disturbance, post-1977 mining disturbance (including areas disturbed by mining prior to 1977 that were subsequently used for mining activity), or disturbed by other activities. Most disturbed sites are in such condition that vegetation growth is limited, if it is allowed at all. Although isolated patches of species usually associated with the various natural vegetation types occur within and on the edges of adjacent disturbed areas, most species growing in those sites are primary succession species and are considered weeds: Salsola kali, Kochia scoparia, and Convolvulus arvense. Chrysothamnus nauseosus, a shrub species that invades disturbed sites, commonly grows on the edges of disturbed areas.

3.2 THREATENED AND ENDANGERED SPECIES

No threatened or endangered plant species (Federal Register, December 15, 1980) was found on the area.

No threatened or endangered plant species presently listed is known to occur in Carbon County; however, the occurrence of Eriogonum corymbosum var. davidsei and Eriogonum lancifolium, two species recommended for endangered listing, was reported by Welsh and Thone (1979). Eriogonum corymbosum var. davidsei occurs in a desert shrub community near Price. It occurs at approximately 5500 feet elevation in clay soil on a steep

hillside on the Mancos Shale Formation. Eriogonum lancifolium is also found on the Mancos Shale Formation and usually occurs in association with scattered juniper in salt desert shrub communities between 4900-5700 feet. It is found on gray clay soils. Neither of these species is known to occur on the Mine Plan Area.

3.3 VEGETATION ON REFERENCE AREAS AND POTENTIALLY AFFECTED VEGETATION TYPES

3.3.1 Sample Adequacy

Sample adequacy was calculated for all vegetative cover, shrub density, and tree density data gathered on the Mine Plan Area. All data met or exceeded the desired confidence level except for shrub density on the Barn Canyon pinyon-juniper affected area (Table 3.2). Desired confidence level for this data was 80 percent and the confidence level achieved was 79.4 percent (Table 3.2). One additional shrub transect would have been sufficient to exceed the desired confidence level; however, a snowstorm hit the Study Area on the last day of the field trip and, given the weather conditions, it was not practical to attempt additional sampling in the area.

3.3.2 Affected Areas and Corresponding Reference Areas

The list of affected areas and corresponding reference areas is given in Table 3.3. A comparison of vegetation data from the types in Barn Canyon that may be affected and the equivalent reference areas is provided in Table 3.4. Since the other affected areas were already disturbed, there are no baseline vegetation data for statistical comparison with reference area data. Although the reference area selection for the disturbed areas was more subjective than for the Barn Canyon types, the reference areas chosen are typical what would have been present in the disturbed sites due to the similarity of slope, aspect, and elevation as well as the proximity to areas they represent. Reference areas for the disturbed sites provide the basis for reclamation success standards; however, final reclamation success criteria will also have to take other factors, such as actual vegetation

Table 3.2 Statistical Adequacy of Vegetation Data for the Price River Coal Company's Mine Area, 1981

Sampling Area	Vegetation Cover			Shrub Density			Tree Density		
	N_{min}	n	CLA	N_{min}	n	CLA	N_{min}	n	CLA
REFERENCE AREAS:									
Sowbelly Grass Sage	11	15	92.8	2	15	99.6	NA.....		
Sowbelly Mixed Brush	14	15	91.0	2	15	98.8	NA.....		
Willow Creek Grass-Sage	7	15	97.4	5	15	93.7	NA.....		
Castle Gate Riparian	13	15	91.6	24	28	82.1	.....AC.....		
Castle Gate Mixed Brush	7	15	96.6	6	15	91.0	NA.....		
Crandall Riparian	23	24	90.3	.....AC.....			.....AC.....		
Crandall Conifer	6	15	97.4	3	15	96.5	22	28	83.1
Crandall Pinyon-Juniper	1	15	100.0	8	15	87.7	.....PC.....		
Barn Canyon Grass-Sage	4	15	99.5	8	15	88.1	NA.....		
Dry Canyon Mixed Brush	3	15	99.7	3	15	97.7	NA.....		
AFFECTED AREAS:									
Barn Canyon Pinyon-Juniper	7	15	97.2	16	15	79.4	.....PC.....		
Barn Canyon Mixed Brush	13	15	91.9	6	15	90.7	NA.....		
Barn Canyon Grass-Sage	5	15	98.7	4	15	95.5	NA.....		
Barn Canyon Conifer	3	15	99.7	12	15	82.1	11	15	83.4

N_{min} = minimum sample size to meet desired confidence levels
n = sample size collected
CLA = Confidence Level Achieved
AC = Absolute Count
NA = Not Applicable
PC = Photo Count

Table 3.3

List of Affected Areas and Corresponding Reference Areas
Price River Coal Company's Mine Plan Area, 1981

Affected Area	Reference Area
Sowbelly and Hardscrabble Mines	Sowbelly Mixed Brush Sowbelly Grassland-Sagebrush
Willow Creek Disturbed Area	Willow Creek Grassland-Sagebrush
Castle Gate Prep Plant	Castle Gate Mixed Brush Castle Gate Riparian Bottom Barn Canyon Grassland-Sagebrush
Crandall Canyon Shaft Site	Castle Gate Mixed Brush Crandall Conifer Crandall Riparian Bottom
Crandall Canyon Leach Field	Barn Canyon Grassland-Sagebrush Castle Gate Mixed Brush Crandall Conifer
Barn Canyon Conifer[a]	Crandall Conifer
Barn Canyon Pinyon-Juniper[a]	Crandall Pinyon-Juniper
Barn Canyon Mixed Brush[a]	Dry Canyon Mixed Brush
Barn Canyon Grassland-Sagebrush[a]	Barn Canyon Grassland-Sagebrush

[a] Future refuse disposal area not presently affected.

Location and Reference Areas at Location

Barn Canyon - Grassland-Sagebrush
Crandall Canyon - Pinyon-Juniper, Riparian Bottom, Conifer
Castle Gate Prep Plant Area - Riparian Bottom, Mixed Brush
Sowbelly Canyon - Mixed Brush, Grassland-Sagebrush (2)
Willow Creek Canyon - Grassland-Sagebrush
Dry Canyon - Mixed Brush

Table 3.4 Comparison of Vegetation Data from Affected Areas in Barn Canyon and Corresponding Reference Areas, 1981

Vegetation Type	Vegetative Cover		Shrub Density	Tree Density	Species Similarity Index
	Percent	t[1/]	#/ha	#/ha	Percent
Barn Canyon Grass-Sage Affected	54.4		6449.0	NA	
Barn Canyon Grass-Sage Reference	53.2	0.528	2421.8	NA	50
Barn Canyon Mixed Brush Affected	64.3		11,823.1	NA	
Dry Canyon Mixed Brush Reference	64.3	0.000	8054.4	NA	60
Barn Canyon Pinyon-Juniper Affected	56.9		2979.6	176.8	
Crandall Pinyon-Juniper Reference	53.1	1.651	2653.1	202.0	71
Barn Canyon Conifer Affected	72.9		4285.7	255.7	
Crandall Conifer Reference	74.4	0.455	12,952.4	961.6	54

1/ $t_{(95)} = 2.048$; therefore, there was no significant difference in vegetation cover on any of the four affected types and their respective reference areas.

cover prior to mining disturbance (e.g., there was previously a village on the site of the Castle Gate Preparation Plant) as well as dates of disturbance into consideration.

Vegetative cover on all reference areas was not significantly different (t=.05) from their corresponding affected area in Barn Canyon (Table 3.4). All vegetative species similarity indices were 50 percent or greater.

3.3.3 Data Presentation

Summarized cover data for all areas sampled on the Mine Plan Area are presented in Table 3.5, shrub density data are in Table 3.6, tree density data are in Table 3.7, and productivity estimates are in Table 3.8. A brief description of the location and a summary of vegetation data on each of the aeas sampled during the study are presented below. Complete vegetation data for each area is given in Appendix C.

3.3.3.1 Sowbelly grass-sage reference area. The sowbelly grass-sage reference area is located in Sowbelly Canyon in SW1/4 Section 4, T13S, R9E (Maps 1 and 2). To be comparable to the slope and aspect of the disturbed sites, this reference is comprised of two parts, one on a southwest aspect and the other on a northeast aspect. Vegetative cover on the sowbelly grass-sage reference area was 39 percent, litter-rock was 44 percent, and bare ground was 16 percent (Table 3.5). Forty-seven percent of the vegetation cover was *Agropyron* spp. and 28 percent was *Artemisia tridentata*, which were also species encountered with 100 percent frequency among the transects. Eleven species were encountered on the cover transects in the Sowbelly grass-sage reference area, which had a species diversity index of 1.373. *Artemisia tridentata* accounted for 96 percent of the 8816 mean shrubs per ha on this reference area (Table 3.6). Mean height of all shrubs was 19 cm. Production on the area was estimated to be 900 lbs per acre (Table 3.7).

Table 3.5 Summary Cover Data for Reference and Affected Areas on Price River Coal Company's Mine Plan Area, 1981

Sampling Area	Vegetative Cover (%)		Litter/Rock (%)		Vegetation, Litter/Rock (%)		Bare Ground		# of Species	Species Diversity Index
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s		
REFERENCE AREAS:										
Sowbelly Grass-Sage	38.9	7.3	44.5	8.2	83.5	9.1	16.5	9.1	11	1.373
Willow Creek Grass-Sage	39.6	5.6	33.5	10.5	73.1	6.7	26.9	6.7	17	1.578
Barn Canyon Grass-Sage	53.2	5.7	45.7	5.5	98.9	2.1	1.1	2.1	17	2.250
Sowbelly Mixed Brush	47.7	9.8	38.3	10.7	86.0	5.9	14.0	5.9	24	1.940
Castle Gate Mixed Brush	40.9	6.1	35.2	6.0	76.1	6.6	23.9	6.6	12	1.484
Dry Canyon Mixed Brush	64.3	6.3	32.7	5.6	96.9	4.7	3.1	4.7	22	1.642
Crandall Pinyon-Juniper	53.1	3.5	37.1	5.4	90.1	4.6	9.9	4.6	13	1.985
Castle Gate Riparian	56.4	11.3	20.3	8.3	76.7	12.4	23.3	12.4	41	2.958
Crandall Riparian	47.2	12.6	34.6	9.8	81.8	7.5	18.2	7.5	36	2.424
Crandall Conifer	74.4	10.4	20.4	9.5	94.8	5.2	5.2	5.5	23	1.379
AFFECTED AREAS:										
Barn Canyon Grass-Sage	54.4	6.7	34.9	9.0	89.3	6.6	10.7	6.6	17	1.846
Barn Canyon Mixed Brush	64.3	12.6	33.7	12.3	98.0	2.9	2.0	2.9	32	2.682
Barn Canyon Pinyon-Juniper	56.9	8.2	31.7	9.3	88.7	7.0	11.3	7.0	17	1.599
Barn Canyon Conifer	72.9	7.4	24.3	7.9	97.2	3.2	2.8	3.2	24	2.317

Table 3.6 Summary Shrub Density and Height Data for Reference and Affected Areas on Price River Coal Company's Mine Plan Area, 1981

Sampling Areas	Percent Frequency - Height Classes[1]							Height (cm)		Total Counted	Density (#/ha)	
	A	B	C	D	E	F	G	$\bar{x}$	s		$\bar{x}$	s
REFERENCE AREAS:												
Sowbelly Grass-Sage	26.3	67.4	3.7	1.7	0.6	0.3	0.0	19.4	21.7	648	8816.3	1832.2
Willow Creek Grass-Sage	5.4	30.1	38.3	24.9	1.2	0.0	0.0	42.2	25.2	1307	17,782.3	6351.8
Barn Canyon Grass-Sage	25.3	12.9	25.3	26.4	10.1	0.0	0.0	48.9	42.9	178	2421.8	1120.1
Sowbelly Mixed Brush	12.2	29.5	17.2	18.0	17.0	4.9	1.2	71.7	79.9	760	10,340.1	2528.7
Castle Gate Mixed Brush	13.5	23.0	27.4	28.0	5.7	2.4	0.0	53.1	52.6	453	6163.3	2539.9
Dry Canyon Mixed Brush	0.3	2.9	18.6	15.9	20.6	12.2	29.6	205.9	148.2	592	8054.4	2212.7
Crandall Pinyon-Juniper	0.0	18.5	16.4	19.5	13.8	6.7	25.1	166.4	152.9	195	2653.1	1253.3
Castle Gate Riparian	6.4	14.9	23.1	19.1	15.9	19.6	1.1	113.9	107.4	377	2747.8	2246.3
Crandall Riparian	8.2	31.7	26.5	20.7	8.2	4.0	0.6	59.6	67.7	328	404.9	---
Crandall Conifer	52.5	31.4	13.3	2.5	0.1	0.1	0.0	16.6	18.4	952	12,952.4	3914.9
AFFECTED AREAS:												
Barn Canyon Grass-Sage	12.9	19.0	38.4	21.7	8.0	0.0	0.0	48.1	37.5	474	6449.0	2085.2
Barn Canyon Mixed Brush	0.5	5.3	20.4	14.0	17.5	12.1	30.3	203.6	152.3	869	11,823.1	4907.3
Barn Canyon Pinyon-Juniper	5.5	11.0	14.6	17.4	20.1	12.3	19.2	165.4	143.0	219	2979.6	1990.3
Barn Canyon Conifer	8.6	1.9	13.0	35.6	28.3	4.8	7.9	121.2	104.8	315	4285.7	2544.3

[1] Height classes:

Code	Range (cm)	Mid-Point (cm)
A	0-10	5
B	11-30	20
C	31-50	40
D	51-100	75
E	101-200	150
F	201-400	300
G	Over 400	-

Table 3.7 Summary Tree Density Data for Reference and Affected Areas on Price River Coal Company's Mine Plan Area, 1981

Vegetation Type	Density (#/ha)	Mean Basal Area (cm^2)
REFERENCE:		
Crandall Pinyon Juniper	42.0	1292.1
Castle Gate Riparian	147.0	969.9
Crandall Riparian	202.0	600.9
Crandall Conifer	961.6	369.0
AFFECTED:		
Barn Canyon Pinyon-Juniper	176.8	589.8
Barn Canyon Conifer	255.7	523.7

Table 3.8 Productivity Estimates for Reference and Affected Areas on Price River Coal Company's Mine Plan Area, 1981

Sampling Area	Productivity lbs/acre[1/]
REFERENCE:	
Sowbelly Grass-Sage	900
Willow Creek Grass-Sage	850 - 900
Barn Canyon Grass-Sage	
Sowbelly Mixed Brush	1200 - 1300
Castle Gate Mixed Brush	650 - 700
Dry Canyon Mixed Brush	
Crandall Pinyon-Juniper	
Castle Gate Riparian	2500 - 3000
Crandall Riparian	2500 - 3000
Crandall Conifer	200 - 300
AFFECTED:	
Barn Canyon Grass-Sage	
Barn Canyon Mixed Brush	
Barn Canyon Pinyon-Juniper	
Barn Canyon Conifer	

1/ Estimates provided by Soil Conservation Service, Price, Utah (Appendix A)

3.3.3.2 Willow Creek grass-sage reference area. The Willow Creek grass-sage reference area is located along Willow Creek in the SW1/4 Section 32, T12S, R10E, (Maps 1 and 3). Vegetative cover on this reference area was 40 percent, litter-rock was 34 percent, and bare ground was 27 percent (Table 3.5). Fifty-eight percent of the vegetation cover was Artemisia tridentata and 35 percent was grasses, primarily Agropyron smithii and Bromus tectorum. Artemisia tridentata occurred with 100 percent frequency while Agropyron smithii and Bromus tectorum both occurred with 73 percent frequency. Seventeen species were encountered along the transects in the Willow Creek grass-sage reference area. The species diversity index was 1.578. Artemisia tridentata accounted for 92 percent of the 17,782 mean shrubs per ha (Table 3.6). Mean height of all shrubs was 42 cm. Production on the area was estimated to be 850 to 900 lbs per acre (Table 3.7).

3.3.3.3 Barn Canyon grass-sage reference area. The Barn Canyon grass-sage reference is located in the NW1/4 Section 36, T12S, R9E (Maps 1 and 3). Vegetative cover was 53 percent, litter-rock was 46 percent, and bare ground was 1 percent (Table 3.5). Agropyron spp. provided 45 percent of the vegetation cover, Bromus tectorum provided 20 percent, Atriplex canescens provided 6 percent, and Artemisia tridentata provided 5 percent. Bromus tectorum was the species encountered with the highest frequency (93 percent) while Agropyron intermedium and other Agropyron spp. were the only other species that occurred with over 75 percent frequency. Seventeen species were encountered along the transects in the Barn Canyon grass-sage reference area, which had a species diversity index of 2.250. Sixty-two percent of the 2422 mean shrubs per ha were Artemisia tridentata and 23 percent were Atriplex canescens. Mean height of all shrubs was 48 cm (Table 3.6). Estimated Production on this area was was _____

3.3.3.4 Barn Canyon grass-sage affected. The grass-sage type covered 21 percent of the 193 acres of potential disturbance in Barn Canyon (Table 3.1) (Sections 25 and 36, T12S, R9E, Maps 1 and 3). Vegetation cover on the grass-sage affected area was 54 percent, litter-rock was 35 percent,

and bare ground was 11 percent (Table 3.5). Fifty-three percent of the vegetative cover was Agropyron intermedium and other Agropyron sp. while 17 percent was Artemisia tridentata. Agropyron intermedium was encountered with 100 percent frequency and Artemisia tridentata occurred with 87 percent frequency. Seventeen species were encountered on the transects in the grass-sage affected area. The species diversity index was 1.846. Artemisia tridentata accounted for 73 percent of the 6449 mean shrubs per ha and Atriplex canescens accounted for 12 percent (Table 3.6). Mean shrub height was 48 cm. Estimated production on the area was ___

3.3.3.5 Sowbelly mixed brush reference area. The Sowbelly mixed brush reference area is located in the bottom of Sowbelly Canyon in the SW1/4 Section 4, T13S, R9E (Maps 1 and 2). Vegetative cover was 48 percent, litter-rock was 38 percent, and bare ground was 14 percent (Table 3.5). Fifty-nine percent of the vegetation cover was Quercus gambelii, 11 percent was Artemisia tridentata, and 14 percent was Agropyron intermedium and other Agropyron species. Quercus gambelii occurred with 100 percent frequency and Artemisia tridentata occurred with 87 percent; all other species occurred with less than 50 percent frequency. Twenty-four species were encountered on the transect in the Sowbelly mixed brush reference area, which had a species diversity index of 1.940. Shrub density on this area was 10,340 per ha (Table 3.6). Forty-nine percent of the shrubs were Quercus gambelii, 30 percent were Artemisia tridentata, and 12 percent were Symphoricarpos occidentalis. Mean height of all shrubs was 72 cm. Estimated production on the Sowbelly mixed brush reference area was 1200 to 1300 lbs per acre (Table 3.7).

3.3.3.6 Castle Gate mixed brush reference area. The Castle Gate mixed brush reference area is located on a westerly-facing slope in the SW1/4 Section 36, T12S, R9E (Maps 1 and 3). Vegetation cover was 41 percent, litter-rock was 35 percent, and bare ground was 24 percent (Table 3.5). Fifty-one percent of the vegetation cover was Agropyron sp., 26 percent was Artemisia tridentata, and 9 percent was Amelanchier utahensis. Agropyron sp. occurred with 100 percent frequency, Artemisia tridentata occurred with

87 percent frequency, and all other species occurred with less than 50 percent frequency. Twelve species were encountered on the cover transects in the Castle Gate mixed brush reference area. Species diversity was 1.484. Seventy-six percent of the 6163 shrubs per ha (Table 3.6) were Artemisia tridentata and 10 percent were Atriplex canescens. Mean shrub height was 53 cm. Production on the Castle Gate mixed brush reference area was approximately 650-700 lbs per acre (Table 3.7).

3.3.3.7 Barn Canyon mixed brush affected. Approximately 14 percent of the 193 acres of potential disturbance in Barn Canyon (Table 3.1) (Sections 25 and 36, T12S, R9E) is classed as mixed brush (Maps 1 and 3). Vegetative cover on the mixed brush type in this area was 64 percent, litter-rock was 34 percent, and bare ground was 2 percent. Shrubs and trees were 70 percent of the vegetative cover with Acer grandidentatum and Quercus gambelii the most common (22 and 17 percent of vegetative cover, respectively). Bromus tectorum, which was the most common grass, was 8 percent of the vegetative cover. The most frequently occurring species were Acer grandidentatum (80 percent freuency), Quercus gambelii (73 percent), and Berberis repens (73 percent). Thirty-two species were encountered on the transects within the mixed brush affected area. Species diversity was 2.682. The most abundant shrubs were Symphoricarpos occidentalis, Acer grandidentatum, and Quercus gambelii which respectively accounted for 30, 30, and 24 percent of the 11,823 shrubs per ha on this type. Mean height of the shrub was 204 cm. Estimated production on the mixed brush affected area was _____

3.3.3.8 Dry Canyon mixed brush reference area. The Dry Canyon mixed brush reference area is located in the NE1/4 Section 32, T12S, R10E (Map 1). Vegetative cover was 64 percent, litter-rock was 33 percent, and bare ground was 3 percent (Table 3.5). Seventy-three percent of the vegetative cover were shrubs and trees with Quercus gambelii (56 percent) and Artemisia tridentata (12 percent) providing the most cover. Agropyron spicatum, Agropyron intermedium, and other Agropyron species provided approximately 20 percent of the vegetative cover. Quercus gambelii occurred with 100

percent frequency, Agropyron sp. occurred with 87 percent frequency, and Artemisia tridentata occurred with 80 percent frequency. The Dry Canyon mixed brush reference area had a species diversity index of 1.642. Twenty-two species were encountered on transects within this area. Sixty-eight percent of the 8054 shrubs per ha on this area were Quercus gambelii, and Artemisia tridentata accounted for 19 percent. Mean height of all shrubs was 206 cm. Production on the area was estimated to be ___

3.3.3.9 Barn Canyon pinyon-juniper affected. The pinyon-juniper type covered approximately 44 percent of the 193 acres of potential disturbance in Barn Canyon (Table 3.1) (Sections 25 and 36, T12S, R9E, Maps 1 and 3). Vegetative cover was 57 percent, litter-rock was 32 percent, and bare ground was 11 percent (Table 3.5). Fifty-six percent of the vegetative cover was Agropyron sp., 14 percent was Juniperus osteosperma, 13 percent was Pinus edulis, and 9 percent was Cercocarpus ledifolius. These same species also had the highest frequency of occurrence among the transects (100, 80, 80, and 67 percent, respectively). Seventeen species were encountered on the cover transects in the Barn Canyon pinyon-juniper type, which had a species diversity index of 1.599. Mean shrub density on this type was 2980 (Table 3.6) with Cercocarpus ledifolius, Artemisia tridentata, Quercus gambelii, and Pinus edulis the most abundant (27, 22, 20, and 11 percent, respectively). Mean height of all shrubs in the pinyon-juniper affected type was 165 cm. Estimated tree density in this type was 177 per ha and mean basal area for all trees was 590 cm^2 (Table 3.7). Fifty-one percent of the trees were Pinus edulis and 34 percent were Juniperus osteosperma. Estimated production on the pinyon-juniper affected type is approximately _____

3.3.3.10 Crandall pinyon-juniper reference area. The pinyon-juniper reference area is located in the NE1/4 Section 29, T12S, R9E in Crandall Canyon (Maps 2 and 4). Vegetative cover on this area was 53 percent, litter-rock was 37 percent, and bare ground was 10 percent (Table 3.5). Agropyron intermedium, Agropyron smithii, and other Agropyron sp. were 35 percent of the vegetative cover, Pinus edulis was 18 percent, Juniperus

osteosperma was 17 percent, and Cercocarpus ledifolius was 14 percent. Agropyron sp. occurred with 100 percent frequency, Cercocarpos ledifolius and Juniperus osteosperma each occurred with 67 percent frequency, and Pinus edulis occurred with 53 percent frequency. Thirteen species were encountered on the cover transects in the pinyon-juniper reference area. The species diversity index was 1.985. Cercocarpos ledifolius and Quercus gambelii were the most abundant (43 and 39 percent, respectively) of the 2653 mean shrubs per ha on the reference area (Table 3.6). Mean height of all shrubs was 166 cm. Tree density on the pinyon-juniper reference area was 202 trees per ha and mean basal area for all trees was 601 cm^2 (Table 3.7). Forty-seven percent of the trees were Juniperus osteosperma, 26 percent were Pinus edulis, and 22 percent were Cercocarpus ledifolius. Estimated production on the area was approximately ____

3.3.3.11 Castle Gate riparian reference area. The Castle Gate riparian reference area is located along the Price River in the SW1/4 Section 26, T12S, R9E (Maps 1 and 3). Vegetative cover was 56 percent, litter-rock was 20 percent, and bare ground was 23 percent (Table 3.5). Thirty-six percent of the vegetative cover was provided by 21 species of forbs, but the most cover of all species was provided by Bromus tectorum (18 percent) followed by Populus angustifolia (15 percent). Bromus tectorum occurred with 87 percent frequency, Clematis lingusticifolia occurred with 73 percent, Quercus gambelii occurred with 53 percent, and all of the other 38 species encountered on the cover transects occurred with less than 50 percent frequency. The Castle Gate riparian reference area had the highest species diversity of all areas sampled (2.958) (Table 3.5). Forty-six percent of the 2748 mean shrubs per ha on this type (Table 3.6) were Rosa sp., 19 percent were Quercus gambelii, and 11 percent were Rhus trilobata. Mean shrub height was 114 cm. Tree density in the Castle Gate riparian reference area was 42 per ha and mean basal area was 1292 cm^2 (Table 3.7). Populus angustifolia was the only tree species in the area. Production on the riparian area was 2500 to 3000 lbs per acre (Table 3.8).

3.3.3.12 Crandall riparian reference area. The Crandall riparian reference area is located in the bottom of Crandall Canyon in the NW1/4 Section 27, T12S, R9E (Maps 1 and 4). Vegetative cover on this area was 47 percent, litter-rock was 35 percent, and bare ground was 18 percent (Table 3.5). Thirty percent of the vegetative cover was Populus angustifolia, 13 percent was Poa sp., 11 percent was Bromus tectorum, and Cynoglossum officinale also provided 11 percent. Poa sp. occurred with 92 percent frequency, Populus angustifolia occurred with 83 percent, Aster sp. occurred with 75 percent, and Cynoglossum officinale occurred with 71 percent frequency among the cover transects in the area. Thirty-six species were encountered on the cover transects in the Crandall riparian reference area, which had a species diversity index of 2.424. Approximately 405 shrubs per ha occur within the area (Table 3.6). Forty-four percent of the shrubs were Symphoricarpos occidentalis, 11 percent were Quercus gambelii, and 10 percent were Ribes cereum. The mean height of shrubs was 60 cm. Tree density in the Crandall riparian reference area was 147 per ha and mean basal area was 970 cm^2 (Table 3.7). Trees in the type were Populus angustifolia, Acer grandidentatum, Juniperus osteosperma, Pseudotsuga menziesii, and Pinus ponderosa. Production on this riparian area was 2500-3000 lbs per acre (Table 3.8).

3.3.3.13 Barn Canyon conifer affected. The conifer type covered approximately 21 percent of the 193 acres of potential disturbance in Barn Canyon Table 3.1) (Sections 25 and 36, T12S, R9E, Maps 1 and 3). Vegetative cover was 73 percent, litter-rock was 24 percent, and bare ground was 3 percent (Table 3.5). Twenty-six percent of the vegetative cover was Agropyron sp., 16 percent was Juniperus osteosperma, 15 percent was Pseudotsuga menziesii, and 13 percent was Quercus gambelii. Species which occurred with the highest frequency among the transects were Agropyron sp. (100 percent), Juniperus osteosperma (100 percent), Pseudotsuga menziesii (87 percent), Quercus gambelii (60 percent), Abies lasiocarpa (53 percent), and Pinus edulis (53 percent). Twenty-four species were encountered along the cover transects in the conifer affected area. The species diversity index on this type was 2.317. Approximately 59 percent of the 4286 shrubs per ha on

this type (Table 3.6) were Quercus gambelii while Symphoricarpos occidentalis and Cercocarpos montanus each provided an additional 11 percent. Mean height of all shrubs was 121 cm. Tree density in the conifer affected type was 256 per ha and mean basal area was 524 cm^2 (Table 3.7). The most abundant trees were Juniperus osteosperma, Pseudotsuga menziesii, Pinus edulis, and Abies lasiocarpa. Estimated production in the conifer type in Barn Canyon was ___

3.3.3.14 Crandall conifer reference area. The conifer reference area is located in Crandall Canyon in the SW1/4 Section 289, T12S, R9E (Maps 1 and 4). Vegetative cover was 74 percent, litter-rock was 20 percent, and bare ground was 6 percent. Pseudotsuga menziesii provided 65 percent of the vegetative cover and Pinus ponderosa provided 14 percent. These two species occurred with 100 and 80 percent frequency, respectively; other frequently occurring species were Symphoricarpos occidentalis (80 percent) and perennial grasses (60 percent). Twenty-three species were encountered along the cover transects in the conifer reference area. The species diversity index for this area was 1.379. Fifty-one percent of the 12,952 shrubs per ha on this area (Table 3.6) were Berberis repens, 35 percent were Symphoricarpos occidentalis, and 13 percent were Quercus gambelii. Mean shrub height was 17 cm. Tree density in the conifer reference area was 962 trees per ha and mean basal area was 359 cm^2 (Table 3.7). Pseudotsuga menziesii, Pinus ponderosa, and Juniperus osteosperma were the most abundant trees. Production in the conifer reference area was approximately 200 to 300 lbs per acre (Table 3.8).

4.0 SUMMARY

The vegetation baseline study for Price River Coal Company's Mine Plan Area near Helper, Utah was conducted during the 1981 growing season by Mariah Associates. Vegetation on the entire Mine Plan Area was mapped. Reference areas were selected and sampled for vegetation types that had occurred on sites that are presently occupied by surface facilities and other disturbance associated with the mine. Baseline vegetation studies were also conducted in an area in Barn Canyon that may be disturbed in the future.

The five major natural vegetation types in the Mine Plan Area were conifer, grassland-sagebrush, mixed brush, pinyon-juniper, and riparian bottom. Disturbance on the area was mapped and identified as either pre-1977 mining disturbance, post-1977 mining disturbance (including areas disturbed by mining prior to 1977 that were also subsequently used for mining activity), or other disturbance. Approximately ___ acres were identified as pre-1977 mining disturbance, ___ acres were post-1977 mining disturbance, and ___acres were identified as other disturbance. Vegetative cover on the 10 reference areas ranged from 39 percent to 74 percent, shrub density ranged from 405 per ha to 17,782 per ha, and species diversity ranged from 1.373 to 1.958. No threatened or endangered plants were encountered during the study.

5.0 LITERATURE CITED

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APPENDIX A

Productivity Estimates From the Soil Conservation Service

Rec. 11/12/81
IK ✓
File # 148

United States Department of Agriculture
Soil Conservation Service
350 N. 400 E.
Price, UT 84501

November 4, 1981

Robert Wiley
Price River Coal Co.
P.O. Box 629
Helper, UT 84526

Dear Bob,

This letter confirms the findings of George Cook when he visited your Price Canyon operation on September 29, 1981. The rangeland productivity estimates by reference area are listed below:

Site #1 (above Castle Gate air vent) - Sagebrush-grass bottom community
850-900 lbs/acre air dry

Site #2 (water tank and sign) - Sagebrush-browse-grass community
650-700 lbs/acre air dry

Site #3 - Riparian community
2500-3000 lbs/acre

Site #4 (upper Crandall Canyon) - Woodland community
understory 200-300 lbs/acre
low production on conifers (ponderosa pine, whitefir, Douglas fir, western red juniper)

Site #5 (lower Crandall Canyon) - Riparian community
2500-3000 lbs/acre air dry

Site #6 (south aspect Sowbelly Canyon) - Salina Wildrye- black sagebrush community
900 lbs/acre

Site #7 (north aspect Sowbelly Canyon) - Gambel oak and grass community
1200-1300 lbs/acre

If we can be of further assistance please contact us in Price.

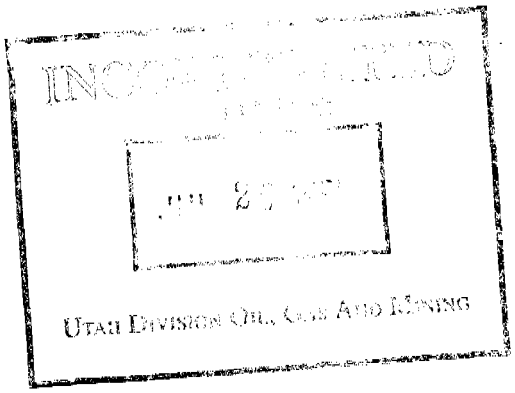
Sincerely,

Gary D. Moreau
District Conservationist
Price/Castle Dale Field Office

GM/lb

Appendix B

Raw Vegetation Data



COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE RIVER COAL COMPANY
HELPER, UTAH

SOUBELLY GRASS-SAGE
REFERENCE SITE
JULY 1981

TRANSECT NUMBER - 1

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ARTRT	1 1 1 1 1 1 1 1
ASTRA	1 1 1
AGROP	1 1 1 1 1 1
PG	1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	9	30	0	0	0	0	0	39

TRANSECT NUMBER - 2

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1 1 1
ASTRA	1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1
OUGA	1 1 1 1 1 1
BG	1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
OUGA	0	0	1	3	0	0	0	4
ARTRT	0	23	0	0	0	0	0	32

TRANSECT NUMBER - 3

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ASTRA	1 1 1 1
ARTRT	1 1 1 1
AGROP	1 1 1 1 1 1 1 1 1
PG	1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	11	14	0	0	0	0	0	25
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 4

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1
ASTRA	1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	10	25	1	0	0	0	0	36
TECA	0	0	1	0	0	0	0	1

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT	1																						1																			1								
AGROP						1				1		1							1								1		1			1	1	1	1		1				1								1	
ERIOG															1																																			
ASTRA																		1							1			1																		1				
PG																																																		1
BG																								1		1																								
LR		1	1	1	1		1	1	1		1		1	1		1	1			1	1	1								1	1					1		1	1	1			1	1	1		1	1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	17	26	0	0	0	0	0	43
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 6

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTFT			1	1	1	1																																												
STPI2	1																															1													1					
ASTRA		1								1											1		1			1				1						1														
AGROP																						1															1		1				1							
PG								1	1			1							1	1				1																1	1									
LR							1				1		1	1	1	1	1	1							1		1	1	1		1		1	1	1			1				1		1		1	1	1	1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTFT	8	28	8	2	0	0	0	46

TRANSECT NUMBER - 7

VEG SPECIES HIT NUMBER

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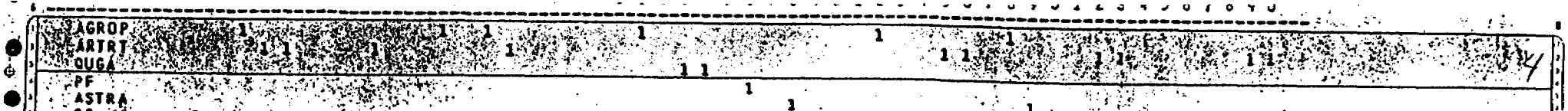
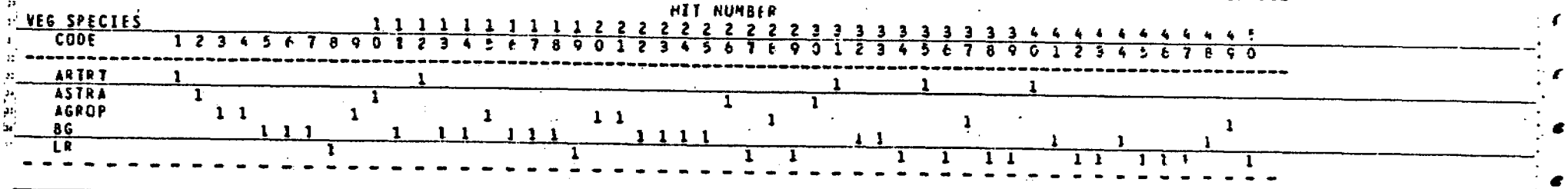


SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	4	34	9	0	0	0	0	47
CHVIV	0	1	0	0	0	0	0	1
OUGA	0	0	0	0	0	2	0	2

TRANSECT NUMBER - 8

VEG SPECIES CODE — HIT NUMBER

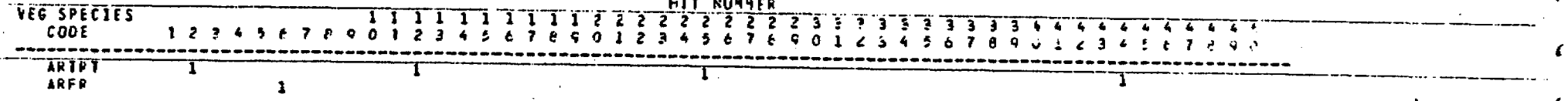


SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	19	40	0	0	0	0	0	59

TRANSECT NUMBER - 9

VEG SPECIES CODE — HIT NUMBER



VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
PIED																		1																																
AGROP																						1					1						1		1			1				1					1			1
[illegible]A																																		1																
BG														1						1			1				1		1										1										1	
LR	1		1	1	1		1	1	1	1	1		1		1	1	1		1		1			1		1				1	1	1				1	1			1	1		1		1	1		1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	21	22	0	0	0	C	0	43
PIED	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 10

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1	1	1	1								1	1		1				1	1						1					1												1	1		1			
ARTRT						1																																		1						1			1	
ASTRA										1																																								
PIED																										1																								
YUCCA																															1																			
BG	1						1		1						1			1				1			1			1					1			1						1								
LR								1			1	1					1		1				1	1					1	1				1	1		1	1	1		1		1					1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	16	33	3	0	0	0	0	52
PIED	0	0	0	0	1	.0	0	1

TRANSECT NUMBER - 11

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1	1								1																									1		1					1			1				1	
ARTRT			1		1																		1					1								1														
PG									1					1	1										1		1																							
BG												1					1	1			1											1						1	1											

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	15	40	1	0	0	0	0	56

TRANSECT NUMBER - 12

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT	1																																																			
AGROP					1					1									1	1					1	1																												
ASTRA													1																																							
BG							1		1							1																																						
LR			1	1		1		1				1	1	1	1					1	1	1																																

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	6	25	0	0	0	0	0	31

TRANSECT NUMBER - 13

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1	1			1	1	1	1	1	1																																										
ARTRT																																																				
ASTRA																																																			
OUGA																																																			
BG																																																			
LR																																																			

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
[illegible]T	7	20	0	0	[illegible]	0	0	27
[illegible]	0	3	0	6	2	0	0	11
JUOS	0	2	0	0	0	0	0	2

TRANSECT NUMBER - 14

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1												1						1						1		1		1			1		1			1			1				1		1			
ARTRT					1						1					1			1			1			1						1						1						1			1				
ASTRA										1																																								
BG			1	1									1					1			1											1							1											
LR	1					1	1	1	1			1			1		1						1	1			1		1					1		1				1		1		1				1	1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
ARTRT	8	36	0	0	0	0	0	44

TRANSECT NUMBER - 15

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1	1		1							1						1				1									1			1																
ARTRT											1															1																				1				
ASTRA															1															1																	1			
BG							1		1	1			1	1		1			1					1	1		1	1				1				1	1		1	1								1		
LR	1			1	1			1									1			1	1		1						1				1		1			1			1	1	1	1	1				1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
ARTRT	10	33	0	0	0	0	0	43

PRICE RIVER COAL COMPANY
HELPER, UTAH

WILLOW CREEK GRASS-SAGE
REFERENCE SITE
SEPTEMBER 1981

TRANSECT NUMBER - 1

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ARTRT	1 1 1 1 1 1 1
BRTET	1 1 1
PF	
SAKA	1
ORHY	1
ATCA	1 1
AGSM	1
CHVIV	1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	5	10	38	2	0	0	56
ATCA	0	0	2	1	0	0	0	3
CHVIV	2	2	0	0	0	0	0	4

TRANSECT NUMBER - 2

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGSM	1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGROP	1
SOLID	1
ATCA	1
BRTET	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	7	31	42	10	0	0	0	90
ATCA	0	2	0	2	0	0	0	4
QUGA	0	2	2	2	1	0	0	7
CHVIV	0	1	0	0	0	0	0	1
AMUTU	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 3

HIT NUMBER

VEG SPECIES CODE	1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28 29 30	31 32 33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48 49 50
AGROP	1	1			
PG		1		1	
ARTRT		1	1	1 1 1	1 1 1
STIPA			1		
JUOS				1	
ORHY					1
PF					1
BG		1	1	1 1 1 1	1 1
LR	1 1 1 1 1	1 1 1 1 1	1 1 1 1	1 1	1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	9	24	4	0	0	0	40
CHVIV	1	4	1	0	0	0	0	6
ATCA	0	0	3	0	0	0	0	3

TRANSECT NUMBER - 4

HIT NUMBER

VEG SPECIES CODE	1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28 29 30	31 32 33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48 49 50
ARTRT	1 1	1 1	1 1	1 1 1	1 1 1 1
PG			1		1
BRTET				1 1 1	1
STIPA					1
BG	1 1 1	1 1 1	1	1 1 1 1 1 1	1 1 1 1
LR	1 1 1 1	1 1	1 1	1	1 1

SHRUB HEIGHT AND DENSITY

10

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	2	23	59	22	2	0	0	108

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10
PG					1					
ARTRT						1		1	1	
AGROP										
ASTRA										
BG		1								
LR	1		1	1			1			1

VEG SPECIES CODE	11	12	13	14	15	16	17	18	19	20
PG										
ARTRT		1				1				
AGROP							1			
ASTRA										
BG	1		1	1	1			1		
LR									1	1

VEG SPECIES CODE	21	22	23	24	25	26	27	28	29	30
PG						1				
ARTRT		1								
AGROP										
ASTRA	1									
BG							1			1
LR			1	1	1			1	1	

VEG SPECIES CODE	31	32	33	34	35	36	37	38	39	40
PG										
ARTRT									1	
AGROP										
ASTRA										
BG			1				1			
LR	1	1		1	1	1		1		1

VEG SPECIES CODE	41	42	43	44	45	46	47	48	49	50
PG									1	
ARTRT	1		1				1			
AGROP										
ASTRA										
BG						1		1		
LR		1		1	1					1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	9	33	10	0	0	0	53
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10
ARTRT						1			1	1
BRTET										
PG										
AGSM										
ATCA										
BOGR										
BG	1	1	1		1			1		
LR				1			1			

VEG SPECIES CODE	11	12	13	14	15	16	17	18	19	20
ARTRT			1			1		1		
BRTET										
PG										
AGSM										
ATCA										
BOGR										
BG	1	1			1		1		1	
LR				1						1

VEG SPECIES CODE	21	22	23	24	25	26	27	28	29	30
ARTRT					1			1		
BRTET			1							
PG										
AGSM										
ATCA										
BOGR										
BG		1								
LR	1			1		1	1		1	1

VEG SPECIES CODE	31	32	33	34	35	36	37	38	39	40
ARTRT	1					1				
BRTET										
PG		1								
AGSM					1					
ATCA									1	
BOGR										
BG								1		
LR			1	1			1			1

VEG SPECIES CODE	41	42	43	44	45	46	47	48	49	50
ARTRT		1			1					
BRTET										
PG			1							
AGSM										
ATCA										
BOGR				1		1	1			
BG								1		1
LR	1								1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
[illegible]T	0	17	88	16	0	0	0	122
ATCA	0	2	3	0	0	0	0	5
CHVIV	0	2	0	0	0	0	0	2

TRANSECT NUMBER - 7

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ORHY	1 1
AGSM	1 1 1 1
PG	1 1 1
PF	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	8	63	29	23	1	0	0	124
ATCA	0	0	2	0	0	0	0	2
CHVIV	1	8	0	0	0	0	0	9

TRANSECT NUMBER - P

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
BRIET	1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ATCA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	10	35	47	1	0	0	94
RHTRT	0	0	0	1	0	0	0	1
CHVIV	1	2	0	0	0	0	0	3
ATCA	0	0	0	2	0	0	0	2

TRANSECT NUMBER - 9

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGSM	1			1												1								1			1	1						1						1					1	1				1
EPVI										1																																								
ARTRT															1																																			
ATCA																		1	1																															
BG		1	1		1												1						1									1	1		1	1	1		1											
LR						1	1	1	1		1	1	1	1						1	1	1			1	1			1	1	1							1			1	1	1	1			1	1	1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	5	14	6	0	0	0	25
EPVI	0	0	0	2	0	0	0	2
ATCA	0	0	2	4	0	0	0	6
CHVIV	0	1	0	0	0	0	0	1
OUGA	0	1	0	1	0	0	0	2

TRANSECT NUMBER - 10

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT	1																		1											1						1	1													
AGROP			1						1																																									
AGSM										1		1													1																									
PG															1					1																				1								1		
BRTET																															1																			
CHNAN																																1																		
BG				1				1								1		1			1					1															1	1	1	1						
LR		1			1	1	1				1		1	1			1					1	1	1			1	1	1				1	1	1			1	1						1	1	1		1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	12	61	40	8	0	0	0	121
CHVIVA	2	5	0	0	0	0	0	7

TRANSECT NUMBER - 13

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
PG					1																										1													1						
ARTRT						1					1	1				1		1		1					1		1								1			1			1	1						1		
ORHY							1																																											
AGSM										1																											1								1					
AGROP																	1																																	
BRTET																												1																						
BG	1							1					1	1												1							1			1							1						1	
LR		1	1	1					1						1				1		1	1	1	1					1	1		1		1					1	1						1	1			1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	17	29	47	0	0	0	94
ATCA	0	0	1	0	0	0	0	1

TRANSECT NUMBER - 14

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT		1														1		1	1			1	1								1	1				1	1		1									1		
AGROP									1																																									
BRTET										1																															1									
SOLID																									1																									
AGSM																																		1												1				
PF																																								1										
PG																																											1		1					
BG					1	1	1					1			1		1				1					1	1	1	1	1								1											1	
LR	1		1	1				1			1		1	1						1				1									1		1							1		1			1			1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	6	61	10	10	0	0	0	87
CHVIV	1	3	0	0	0	0	0	4

TRANSECT NUMBER - 15

VEG SPECIES — HIT NUMBER

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGSM	1																																																		
ARTRT			1								1				1		1		1	1			1	1		1																									1	1	
AGROP										1																																									
BRTET											1																																								
CHNAN																																																		
BG				1	1	1							1			1			1	1			1			1	1			1	1	1																			
LR		1		1				1						1	1						1			1			1	1																							

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
CHNAN	0	0	1	2	0	0	0	3
ARTRT	8	10	14	11	3	0	0	46
CHVIV	2	2	0	0	0	0	0	4
QUGA	0	0	0	2	0	0	0	2
ATCA	0	0	1	0	0	0	0	1

COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE RIVER COAL COMPANY
HELPER, UTAH

BARN CANYON GRASS-SAGE
REFERENCE SITE

OCTOBER 1981

TRANSECT NUMBER - 1

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARLUL	1																																																	
BRTET			1						1																																1	1								
AGINI						1					1				1			1	1											1	1			1	1	1	1	1	1	1									1	
AGSP3										1																																		1						
RIBES																							1	1																										
ARTRT																									1																									
BRIN																																											1							
BG																																													1	1		1		
LR		1		1	1		1	1				1	1	1		1	1			1	1	1				1	1	1	1			1	1														1			1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	-4M	OVER 4M	TOTAL
ARTRT	0	4	2	1	0	0	0	7
RIBES	0	C	0	3	0	0	0	3

TRANSECT NUMBER - 2

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1																										1								1		1				1									
ARTRT			1	1									1	1			1	1																																
AGINI					1																			1	1								1											1				1	1	1
BRTET						1																				1				1				1		1		1												
RIBES															1	1																																		
ARLUL																																								1										
LR		1					1	1	1	1	1	1							1	1	1	1	1					1			1	1							1			1	1		1	1	1			

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	-4M	OVER 4M	TOTAL

15

ARTR	11	0	1	2	2	C	0	16
RIBES	0	0	0	0	2	0	0	2

TRANSECT NUMBER - 3

HIT NUMBER

VEG SPECIES CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
ARTR	1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1
AGINI	1 1 1 1 1 1 1
AF	1 1
BRTET	1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTR	2	3	7	8	1	0	0	21

TRANSECT NUMBER - 4

HIT NUMBER

VEG SPECIES CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BRTET	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGSP3	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARLUL	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ATCA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
XASA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL

ARTRT	5	1	4	3	1	0	0	14
ATCA	3	0	1	0	0	0	0	4

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1	1	1													1	1	1							1				1							1														
BRTET								1	1		1																					1	1				1	1					1			1			1	
AGSP3																						1																												
ARLUL																																												1						
BRIN																																																1		
LR				1	1	1	1			1		1	1	1	1				1	1	1		1	1		1	1	1		1	1			1	1				1	1	1	1			1		1			1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	3	0	1	1	0	0	5
ARTRT	5	3	0	6	0	0	0	14

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
BRIN	1																				1																													
AGROP		1					1	1	1	1	1							1		1			1																											
BRTET			1														1																1	1	1		1		1	1										
AGINI																			1					1	1																									1
ATCA																						1																												
ARLUL																														1	1	1										1								
LR				1	1	1						1	1	1	1	1										1	1	1	1							1		1			1		1	1	1	1	1	1	1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	0	1	1	0	0	0	2
ARTPT	11	0	3	0	0	0	0	14

TRANSECT NUMBER - 7

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1									1													1	1																									
AGSP3			1	1					1																																								1	1
BRTET					1					1																			1																					
PF						1																									1					1														
AMUTU												1	1	1	1																																			
ARTRT																						1																												
BRIN																										1																								
STIPA																											1					1														1				
ARLUL																												1						1																
AGINI																																	1									1	1	1			1			
LR	1						1	1								1	1	1	1	1	1		1							1					1		1	1	1	1	1				1			1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	0	5	0	1	0	0	6
ATCA	0	0	3	0	0	0	0	3
AMUTU	0	0	6	0	1	0	0	7

TRANSECT NUMBER - 8

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGSP3	1						1	1														1																												
AGROP		1	1																													1										1	1	1	1	1	1	1		
AGINI												1																																						
ATCA													1																																					
PF														1																																				
BRTET																							1	1	1	1							1		1															
BRIN																																		1																
LR				1	1	1			1	1	1				1	1	1	1	1	1	1						1	1	1	1	1					1	1	1	1	1	1								1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	[illegible]	OVER 4M	TOTAL

ATCA	0	0	1	1	0	0	0	2
ARTRT	5	1	0	0	0	0	0	6

TRANSECT NUMBER - 9

VEG SPECIES CODE	HIT NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP								1	1						1	1									1	1						1					1	1				1	1							
AGSP3			1																																											1	1			
ARTRT				1																																														
ATCA					1		1				1																																							
OPPO						1																																												
STIPA										1																													1											
BRTET																	1			1																														
BRIN																		1	1																					1										
AGINI																											1																						1	
LR	1	1										1	1	1							1	1	1	1				1	1	1	1		1	1	1	1					1			1	1			1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	1	1	3	0	0	0	5
ARTRT	0	0	1	0	0	0	0	1

TRANSECT NUMBER - 10

VEG SPECIES CODE	HIT NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT	1																																																	
AGROP		1																						1						1	1		1				1			1	1		1	1	1					
PF						1											1								1																									
STIPA							1									1																																		
BRIN								1	1			1																																						
ATCA											1			1																																				
AGSP3																										1								1	1	1														
LR			1	1	1					1			1		1			1	1	1	1	1	1				1	1	1			1						1	1			1				1	1	1	1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	1	0	1	0	0	0	2
ATCA	0	0	1	1	0	0	0	2

TRANSECT NUMBER - 11

VEG SPECIES — HIT NUMBER

CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
AGROP	1 1 1 1 1
BRTET	1 1 1 1 1 1 1
ATCA	1 1 1 1 1 1 1
STIPA	1 1 1 1
BRIN	1 1
OPPO	1
ARLUL	1 1
RIBES	1 1
BG	1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	0	5	1	0	0	0	6
RIBES	0	0	0	0	3	0	0	3

TRANSECT NUMBER - 12

VEG SPECIES — HIT NUMBER

CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ATCA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BRTET	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PF	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BRIN	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGSP3	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGIN1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	0	3	4	1	0	0	8

TRANSECT NUMBER - 13

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AGROP								1										1		1	1				
AGINI							1															1			
BRIN									1																
STIPA												1													
AGSP3													1												
BRTET														1											
PF																									
LR	1	1	1	1	1	1				1	1				1	1	1		1				1	1	1

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1	1																1				1		1
AGINI																									
BRIN																									
STIPA															1										
AGSP3	1															1									
BRTET								1	1	1	1			1						1	1				
PF							1																		
LR				1	1	1						1	1				1	1				1		1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	6	0	0	0	0	0	9

TRANSECT NUMBER - 14

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AGROP				1														1							
BRIN					1	1																			
BRTET							1	1				1					1								
AGINI													1												
PF															1										
RIBES																									
CHNAN																									
LR	1	1	1						1	1	1			1		1			1	1	1	1	1	1	1

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1							1																
BRIN																									
BRTET																			1	1				1	
AGINI												1													
PF																									
RIBES					1	1		1					1	1	1										
CHNAN																		1							
LR	1		1	1			1			1	1					1	1				1	1	1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
RIBES	0	0	0	4	2	0	0	6
CHNAN	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 15

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP												1																				1	1																			1
RIBES					1					1	1																									1	1	1														
AGINI						1	1								1	1																																							
BRTET																						1																		1						1	1	1					1	1	1
AGSP3																																						1															
PF																																										1				1							
ATCA																																										1				1							
LR	1	1	1		1			1			1		1			1	1	1	1	1	1											1			1	1					1			1	1	1				1	1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES — HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
RIBES	0	0	0	2	2	0	0	4
ATCA	0	0	0	4	0	0	0	4
EPHED	0	0	0	1	0	0	0	1

COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE RIVER COAL COMPANY
HELPER, UTAH

BARN CANYON GRASS-SAGE
AFFECTED AREA
OCTOBER 1981

TRANSECT NUMBER - 1

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AMUTU	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AF	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	13	10	0	0	0	0	26
AMUTU	0	0	0	5	7	0	0	12
SYOC	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 2

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AMUTU	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
AMUTU	0	1	1	1	9	0	0	12
ARTRT	4	7	16	3	0	0	0	30
ATCA	0	0	0	1	0	0	0	1

TRANSECT NUMBER - 3

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
EPHED	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	8	27	2	0	0	0	40
AMUTU	0	0	0	1	1	0	0	2
EPHED	0	0	1	0	0	0	0	1
ATCA	0	0	0	1	0	0	0	1

TRANSECT NUMBER - 4

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AMUTU	1
SAKA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
CHAL	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ATCA	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	4	7	0	0	0	0	11
CHVIV	1	0	2	0	0	0	0	3
EPHED	0	0	1	0	0	0	0	1

[illegible]OIU	0	0	0	0	1	0	0	1
ATCA	0	0	1	1	0	0	0	2

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
SAKA	1	1		1	1	1					1	1	1		1	1	1	1	1								1	1															1	1	1	1	1		1	1
ARTRT			1																																															
AGINI								1	1																1						1	1	1					1												
ATCA																																																1		
BG														1							1	1	1	1					1	1					1	1	1				1	1								
LR							1			1										1						1								1					1	1										

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	10	1	0	0	0	0	11
ATCA	0	10	0	3	0	0	0	13

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGINI	1	1					1		1	1	1	1	1	1	1		1		1	1		1		1	1	1			1						1	1	1						1	1	1		1	1	1	
MOSS						1																									1								1											
ATCA																																														1				
BG																											1			1		1						1												
LR			1	1	1			1								1		1			1		1					1					1	1						1	1	1								1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
SYOC	0	0	0	1	0	0	0	1
ARTRT	10	2	3	1	1	0	0	17
CHVIV	0	0	1	0	0	0	0	1
ATCA	0	0	1	0	0	0	0	1

TRANSECT NUMBER - 7

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
CEMOM	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	0	13	8	0	0	0	24
SYOC	0	0	2	0	2	0	0	4
RIBES	0	0	0	1	1	0	0	2
CHVIV	0	0	1	0	0	0	0	1
CEMOM	0	0	0	0	2	0	0	2

TRANSECT NUMBER - 8

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
RIBES	1
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ANTEN	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
RIBES	0	0	0	1	0	0	0	1
ARTRT	8	3	21	1	1	0	0	34
CEMOM	0	0	2	1	3	0	0	6

TRANSECT NUMBER - 9

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
MOSS	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	7	14	16	1	0	0	39
RIBES	0	0	0	1	0	0	0	1
CHVIV	0	0	1	0	0	0	0	1
ATCA	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 10

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGINI	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
RERE	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	5	9	25	2	0	0	42
ATCA	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 11

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGINI	1		1	1			1	1			1	1			1	1	1										1	1				1			1								1	1	1					
ATCA													1									1																1		1										
ARTRT																																				1														
AGROP																																														1				
BG		1								1									1					1									1								1									
LR					1	1			1					1				1		1	1		1		1	1			1	1	1			1			1		1			1					1	1	1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	7	17	1	0	0	0	26
ATCA	0	0	10	2	0	0	0	12

(HEIGHT CLASSES)

TRANSECT NUMBER - 12

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGINI		1	1											1			1																														1			
MOSS								1																																										
AGROP						1				1						1			1			1			1			1													1								1	1
BRTET																		1		1	1									1		1	1		1															
ATCA																																							1											
BG																										1								1		1								1						
LR	1			1	1		1		1		1	1	1		1								1	1			1		1		1						1	1		1		1	1		1	1		1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	2	3	4	0	0	0	9
EPHED	10	0	0	2	1	0	0	13
ARTRT	0	0	3	0	0	0	0	3

(HEIGHT CLASSES)

TRANS[illegible] NUMBER - 13

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
BRTET	1				1		1	1													1				
AGROP				1																					
ATCA						1																			
AGINI													1		1								1		
ARTRT														1											
RIBES																									
ACGR																									
LR		1	1						1	1	1	1				1	1	1	1	1		1		1	1

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
BRTET		1				1					1														
AGROP																						1			
ATCA			1		1													1							
AGINI	1			1															1						
ARTRT								1									1								
RIBES																1									
ACGR																				1					
LR							1		1	1		1	1	1	1						1	1		1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	0	5	4	3	0	0	12
ATCA	0	0	3	5	0	0	0	8
RIBES	0	0	0	2	1	0	0	3

TRANSECT NUMBER - 14

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AGINI	1			1																					
BRTET		1					1		1			1	1	1						1		1	1		
AGROP					1														1					1	
PG																									
ARTRT																									
LR			1			1		1		1	1				1	1	1	1			1				1

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGINI																									
BRTET	1	1		1					1			1	1				1		1					1	
AGROP																1						1			
PG					1	1				1				1											
ARTRT																									1
LR			1				1	1			1				1			1		1	1		1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	0	1	2	1	0	0	4
EPHED	0	0	0	0	1	0	0	1
ARTRT	6	7	0	0	0	0	0	13

TRANSECT NUMBER - 15

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
MOSS	1																																																	
AGROP			1	1																																													1	
ATCA															1	1								1																										
AGINI																	1	1	1						1			1	1			1	1							1										
PG																				1	1	1						1						1				1	1					1		1	1			
ARTRT																																					1					1	1							
BG																															1					1														
LR		1			1	1	1	1	1	1	1	1	1	1									1			1	1								1						1				1			1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
	HEIGHT CLASSES							
ATCA	0	0	1	3	0	0	0	4
ARTRT	10	1	3	4	C	0	0	18
EPHED	C	0	1	0	C	0	0	1

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COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE [illegible]ER COAL COMPANY
HELPER, UTAH

SOWBELLY MIXED BRUSH
REFERENCE SITE
JULY 1981

TRANSECT NUMBER - 1

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
STCO3	1	1																																																
SYOC				1	1																																													
AGINI							1	1											1								1	1	1																					
PF									1	1								1																																
ARLUL																1																																		
QUGA																														1					1	1				1		1	1		1	1	1		1	1
ASTRA																																	1																	
BG						1					1	1	1	1	1							1		1		1								1					1					1						
LR			1														1			1	1		1		1						1	1					1	1			1							1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	4	8	0	12	4	0	0	28
ARTRT	1	10	0	0	0	0	0	11
SYOC	0	2	0	0	0	0	0	2
CHVIV	0	3	0	0	0	0	0	3

TRANSECT NUMBER - 2

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA	1	1	1	1		1									1																							1												
AGINI														1																																				
PG																								1							1																			
ARTRT																							1					1																						
SYOC																													1																				1	
ACGR																																									1			1						1
BG									1				1												1																									
LR					1		1	1		1	1	1				1	1	1	1	1	1	1				1	1			1		1	1	1	1	1	1		1	1		1	1		1	1	1	1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUG	1	10	7	2	4	0	0	24
ARTRT	5	8	0	0	0	0	0	13
CEMON	0	1	0	0	1	0	0	2
SYOC	9	7	0	0	0	0	0	16
ACGR	3	1	0	0	0	0	0	4

TRANSECT NUMBER - 3

VEG SPECIES — HIT NUMBER

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA					1	1				1	1	1	1	1																																						1		
ASTRA															1																																						
ARTRT																									1									1				1	1														
PG																																				1																
BG																	1	1														1	1																				
LR	1	1	1	1			1	1							1	1			1	1		1	1			1			1																							

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	1	5	4	6	1	0	17
SYOC	4	3	0	0	0	0	0	7
ARTRT	10	15	1	0	0	0	0	26
CHVIV	1	0	1	0	0	0	0	2

TRANSECT NUMBER - 4

VEG SPECIES — HIT NUMBER

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA	1			1	1	1																																													
ARTRT												1					1																																			
BERE													1																																							
LUPIN																		1																																		
SYOC																			1																																	
KOSC																					1																														
ACGR																						1	1	1																											
AGINI																															1				1										1					
BG									1				1	1					1						1		1	1		1			1			1														
LR	1	1				1	1	1		1					1	1				1	1								1	1	1					1	1														

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SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	6	2	6	2	3	1	20
AMUTU	0	0	0	1	0	0	0	1
SYOC	1	2	9	0	0	0	0	12
ARTRT	2	4	9	2	0	0	0	17
BERE	19	0	0	0	0	0	0	19
ACGR	0	0	0	0	0	1	0	1

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA		1					1					1	1	1									1	1			1		1		1				1	1	1													
ASTRA				1																																														
ARTRT																	1											1										1				1	1							
AGINI																					1																			1										
LUPIN																																													1					
JUOS																																																	1	1
BG																		1												1			1								1			1		1	1	1		
LR	1		1		1	1		1	1	1	1				1	1			1	1		1			1	1						1		1					1											

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	0	3	11	11	0	0	25
ARTRT	2	3	3	3	0	0	0	11
SYOC	1	0	1	0	0	0	0	2

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
PIPO																																														1	1			
QUGA																																			1			1										1	1	
AGINI						1																							1																					
[illegible]							1															1		1																										

ARTRT							1															1		1																										
E[illegible]																1																																		
PI[illegible]																	1																																	
APLUL																														1																				
AMUTU																																					1													
SYOC																																									1		1							1
BG		1						1	1	1	1			1							1				1	1																								
LR	1		1	1	1							1	1		1			1	1	1			1				1	1			1	1	1	1		1			1	1		1		1	1					

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
ARTRT	1	11	4	1	0	0	0	17
CHVIV	0	2	2	0	0	0	0	4
QUGA	0	13	5	1	7	2	0	28
SYOC	4	8	2	C	0	0	0	14
AMUTU	0	0	1	0	0	0	0	1
PRVID	3	3	0	0	0	C	0	6

TRANSECT NUMBER - 7

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA																															1			1	1	1	1	1	1	1		1								
AGINI	1				1																						1					1																		
ARTRT			1	1		1																																												
AGTR										1																																	1							
JUOS											1	1	1	1	1																																			
PG																																													1					
PIED																		1	1																															
SYOC																				1																														
BG		1														1							1										1								1						1	1		
LR							1	1	1								1				1	1		1	1	1		1	1	1														1		1			1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
QUGA	0	0	0	4	13	0	0	17
ARTRT	5	15	10	5	1	0	0	36
SYOC	0	3	0	0	0	0	0	3

TRANSECT NUMBER - 8

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGINI	1 1 1
QUGA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1
ASTRA	1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	1	2	5	21	6	0	35
ARTRT	0	10	2	0	1	0	0	13
SYOC	6	0	2	1	0	0	0	9

TRANSECT NUMBER - 9

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
QUGA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
SYOC	1
JUOS	1 1 1
ARLUL	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	0	12	17	4	0	3	33
SYOC	0	0	1	0	0	0	0	1
ARTRT	0	2	0	0	0	0	0	2

TRANSECT NUMBER - 10

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1								1																								1																1	1
ARTRT				1																																									1					
QUGA											1							1				1			1			1	1					1	1			1	1	1								
JUOS													1	1	1					1	1																												
ARLUL																																															1			
BG									1																						1											1							
LR		1	1		1	1	1	1			1					1	1	1		1				1	1		1	1			1			1			1	1	1					1		1		1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	1	9	3	2	0	C	0	15
QUGA	0	0	1	12	8	4	0	25

TRANSECT NUMBER - 11

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA	1																						1	1	1			1	1			1	1			1					1	1			1	1		1		1	1
BRTET			1					1	1																																									
ARTRT										1																																								
ACMIM															1																																		
PENST																				1																							1							
SYOC																1																					1													
ROSA																									1														1										
AMUTU																													1																				
BG							1												1																	1			1													
LR		1		1	1	1					1	1	1	1			1	1			1					1				1			1					1					1				1		1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	12	5	2	4	11	3	37
ARTRT	2	5	1	0	0	0	0	8
CHVIV	0	2	0	0	0	0	0	2
SYOC	2	8	0	0	0	0	0	10
ROSA	C	3	2	3	0	C	0	8
AMUTU	0	2	0	C	1	0	0	3

TRANSECT NUMBER - 12

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
SYOC	1 1
QUGA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1
AGROP	1
BG	1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	3	1	2	5	5	5	21
ARTRT	0	4	0	0	1	0	0	5
BERE	4	0	0	0	0	0	0	4
SYOC	1	8	1	0	0	0	0	10
CHVIV	0	0	2	0	0	0	0	2
ROSA	0	5	2	1	0	0	0	8

TRANSECT NUMBER - 13

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
QUGA	1 1 1 1
AGROP	1 1 1
ARTRT	1 1 1 1
PG	1
STCO3	1
ARLUL	1 1
LUPIN	1
PENST	1 1
KOSC	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	0	0	2	0	0	4	

QUGA	0	0	0	2	2	0	0	4
ARTR	0	2	14	8	1	0	0	25
SYO[illegible]	0	1	1	0	0	0	0	2
CHV[illegible]	0	1	2	0	0	0	0	3

TRANSECT NUMBER - 14

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA		1		1	1			1		1	1	1		1				1			1	1																														
JUOS						1	1																																													
ARTR																															1	1			1															
AGROP																																		1																
BG	1																																1											1	1	1	1		1		1
LR			1							1				1	1		1	1	1				1	1		1							1			1	1	1		1	1								

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	3	3	10	19	4	0	39
SYOC	0	1	0	0	0	0	0	1
ARTR	0	1	0	5	1	0	0	7

TRANSECT NUMBER - 15

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
QUGA	1	1	1		1			1		1							1	1	1	1	1				1																										
JUOS						1	1						1	1																																							
ARTR																						1															1		1			1		1	1		1				
AGROP																																	1		1											1		1		
BG			1																		1																							1		1			1		
LR							1		1	1				1	1		1	1		1	1		1	1	1		1		1																						

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	0	4	4	12	0	0	20
AR[illegible]T	1	1	5	11	[illegible]	0	0	18

40

ARTRT	1	1	5	11	0	0	0	18
SYOC	0	1	0	0	0	0	0	1

COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE RIVER COAL COMPANY
HELPER, UTAH

CASTLE GATE MIXED BRUSH
REFERENCE SITE
JULY 1981

TRANSECT NUMBER - 1

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AMUTU	7 18 19 20
AGROP	2 4 11 25
ARTRT	26 36
ORHY	29 30 31 38 40 44 48
BG	1 2 4 5 9 10 14 15 16 17 21 22 27 28 33 34 41 42 45 46
LR	3 23 24 32 35 37 39 43 47 49 50

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
AMUTU	0	0	0	0	0	2	0	2
EPVI	0	0	0	1	0	0	0	1
ARTRT	4	5	5	13	0	0	0	27
CHNAN	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 2

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AMUTU	1 2
ARTRT	3 5 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	4 6
PIED	
BG	1 33
LR	2 34

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	8	18	15	3	0	0	44
AMUTU	0	1	0	0	0	1	0	2

CHNAN	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 3

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ARTRT			1							1	1																																							
AGROP				1								1	1					1			1				1				1							1											1			1
ORPY															1		1																																	
ATCA																							1			1											1						1							
AGSP3																								1																										
BG					1			1								1						1					1						1								1	1			1	1				
LR	1	1				1	1		1					1					1	1								1		1	1	1		1	1			1	1	1				1				1	1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	4	8	6	2	0	0	20
ATCA	0	1	7	2	1	0	0	11
CHNAN	0	0	0	1	0	0	0	1

TRANSECT NUMBER - 4

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGSP3		1																																																
AGROP						1					1	1							1				1						1	1				1																
ARTFT															1	1																1					1					1								
ORHY																	1																																	1
EPVI																											1	1																						
ATCA																																											1							
CHNAN																																																	1	
BG									1	1			1								1	1		1	1	1							1		1	1		1							1	1	1	1		
LF	1		1	1	1		1	1						1				1		1											1								1	1	1			1						

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	2	4	3	4	1	0	0	14
EPVI	0	0	0	0	1	0	0	1
C[illegible]N	0	0	2	2	[illegible]	0	0	4
A[illegible]	0	1	0	0	[illegible]	0	0	1

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP		1		1		1				1	1				1				1		1			1	1		1		1								1		1			1				1			1	
ARTRT																1																																		
ATCA																															1									1			1							
BG												1	1																	1		1	1			1									1					
LR	1		1		1		1	1	1					1			1	1		1		1	1			1		1						1	1			1			1			1			1	1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
CHNAN	0	0	1	0	0	0	0	1
ATCA	1	0	4	1	0	0	0	6
ARTRT	12	2	1	2	0	0	0	17

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP	1									1				1	1					1		1	1	1		1										1	1	1	1			1							1	1
ATCA																			1																															
BG				1		1	1	1				1						1							1									1									1	1						
LR		1	1		1				1		1		1			1	1				1						1	1	1	1	1	1	1		1					1	1				1	1	1	1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	0	1	0	0	0	0	1
ATCA	1	1	2	1	0	0	0	5
EPVI	0	0	1	0	0	0	0	1
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 7

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ORHY	1
ARTRT	1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
CHVIV	1	8	0	0	0	0	0	9
AMUTU	0	0	0	0	0	1	0	1
CHNAN	0	2	0	1	0	0	0	3
ARTRT	2	2	3	3	1	0	0	11

TRANSECT NUMBER - 8

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1 1 1 1 1 1 1
ORHY	1
ARTRT	1 1 1 1 1 1 1 1 1 1 1
AMUTU	1 1 1 1 1 1
ATCA	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	10	17	13	3	1	0	0	44
RHTRT	0	0	0	1	0	0	0	1
AMUTU	0	0	0	0	1	1	0	2
ATCA	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 9

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGROP	1 1 1 1 1
JUOS	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	7	7	9	13	2	0	0	38
CHVIV	0	1	0	0	0	0	0	1
JUOS	0	0	0	0	1	0	0	1

TRANSECT NUMBER - 10

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AMUTU	1 1
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	3	7	6	12	0	0	0	26
AMUTU	0	1	1	2	1	0	0	5
CHNAN	0	0	1	1	0	0	0	2

TRANSECT NUMBER - 11

VEG SPECIES	HIT NUMBER
CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARTRT	1 1
BRTET	1
CHVIV	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
CHNAN	0	0	1	2	0	0	0	3
ARTRT	3	4	2	0	0	0	0	9
PRVID	0	0	0	0	1	0	0	1
POAN	0	0	0	0	1	1	0	2
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 12

VEG SPECIES	HIT NUMBER
CODE	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
CHNAN	1
BRTET	1 1 1 1 1
ATCA	1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
CHNAN	0	1	0	0	0	0	0	1
ATCA	0	3	6	2	0	0	0	11
EPVI	0	0	1	0	0	0	0	1
ARTRT	0	0	0	1	0	0	0	1
CHVIV	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 13

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1 1 1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1
EPVI	1 1
CHNAN	1 1
ORHY	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	4	11	8	0	0	0	23
EPVI	0	0	0	0	1	0	0	1
CHNAN	0	1	0	1	1	0	0	3

TRANSECT NUMBER - 14

VEG SPECIES CODE	HIT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1
ORHY	1 1
ARTRT	1 1 1 1 1 1 1 1 1 1 1 1 1
AGSP3	1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ATCA	0	2	1	5	0	0	0	8
ARTRT	15	3	5	11	0	0	0	34
JUOS	0	0	0	1	0	0	0	1
AMLTL	0	1	0	0	0	0	0	1

TRANSECT NUMBER - 15

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AGROP			1				1				1								1						1
BRTET						1																			
AMUTU								1	1	1															
ARTRT																					1				
BG		1		1										1	1	1	1								
LR	1				1							1	1					1		1		1	1	1	

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP																									
BRTET																									
AMUTU																									
ARTRT							1	1		1	1	1	1				1			1					
BG	1		1	1		1																1	1		1
LR		1			1				1					1	1	1		1	1		1			1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
	HEIGHT CLASSES							
ARTRT	0	9	11	11	1	0	0	32
AMUTU	0	0	0	0	2	5	0	7
JUOS	0	0	0	0	2	0	0	2
ATCA	0	0	0	1	0	0	0	1

COVER AND SHRUB HEIGHT AND DENSITY DATA SHEET

PRICE RIVER COAL COMPANY
HELPER UTAH

BARN CANYON-MIXED BRUSH
AFFECTED AREA
OCTOBER-1981

TRANSECT NUMBER - 1

VEG SPECIES CODE — HIT NUMBER

CODE	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
QUGA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACGR	1
JUOS	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
PG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ORHY	
BERE	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	HEIGHT CLASSES 0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
QUGA	0	0	0	1	1	0	15	17
ACGR	0	0	0	0	0	0	37	37
JUOS	0	0	0	1	0	0	1	2

TRANSECT NUMBER - 2

VEG SPECIES CODE

CODE	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
ACGR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
JUDS	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AGROP	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
SYDC	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BERE	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ARLUL	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ABCD	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
RIBES	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
QUGA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
BG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LR	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ACGR	0	0	0	0	1	5	26	32
JUDS	0	0	0	0	0	0	4	4
ARTRT	0	1	0	2	0	0	0	3
SYOC	1	1	23	0	0	0	0	25
ABCO	0	0	1	1	1	0	1	4
RIBES	0	0	0	0	4	0	0	4
QUGA	0	0	0	1	3	0	0	4

TRANSECT NUMBER - 3

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ACGR		1								1				1																																				
AGROP					1		1								1																				1															
AF								1																																										
JUDS																1	1	1																																
PSMEM																					1	1	1																											
ABCO																								1																										
QUGA																															1	1	1	1			1							1	1	1	1	1	1	1
PIED																																						1												
BERE																																							1	1		1								
LR	1		1	1		1			1		1	1	1						1	1	1					1	1	1	1	1						1					1		1							

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES

HEIGHT CLASSES

CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ACGR	0	0	0	1	3	0	4	8
PSMEM	0	0	0	1	0	0	1	2
JUDS	0	0	0	0	1	0	1	2
SYOC	0	8	0	0	0	0	0	8
ABCO	0	0	0	0	0	0	1	1
QUGA	0	0	4	3	6	0	13	26
RIBES	0	0	0	2	0	0	0	2
PIED	0	0	0	0	0	0	1	1

TRANSECT NUMBER - 4

HIT NUMBER

VEG SPECIES 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 5
CODE 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

ARLUL	1											1																																						
ACGR		1	1	1	1																																										1			
OUGA						1	1	1	1	1																	1						1									1	1	1						
BERE																		1	1												1	1		1			1													
AGROP											1										1			1					1									1												
SYOC													1	1	1																														1					
RIBES																1																				1										1				
LR																	1			1		1	1		1	1		1		1					1				1	1	1							1	1	1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
ACGR	0	0	0	0	21	5	0	26
OUGA	0	0	1	2	7	27	9	46
SYOC	0	1	5	30	0	0	0	36
RIBES	0	0	0	1	3	1	0	5
ARTRT	0	0	0	1	1	0	0	2

TRANSECT NUMBER - 5

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
SYOC						1													1																1								1							
OUGA		1	1				1	1	1			1	1															1	1	1	1														1	1	1	1	1	1
DECA	1			1							1						1	1																				1	1			1								
ACGR																				1		1	1	1	1	1	1					1				1	1				1									
LR					1					1				1	1	1					1												1	1						1				1						

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
OUGA	0	0	0	0	2	3	21	26
SYOC	0	1	35	0	0	0	0	36
ACGR	0	0	0	0	3	0	8	11

TRANSECT NUMBER - 6

HIT NUMBER

VEG SPECIES 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 5

CODE	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
BERE	1							1	1																
MOSS				1																					
PG					1					1															
BRTET						1																			
ACGR											1	1	1	1	1	1	1	1	1						
SYOC																				1					
AGINI																							1		
PF																									1
QUGA																									
CELEL																									
LR		1	1				1														1	1		1	

CODE	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
BERE																									
MOSS																									
PG																									
BRTET							1																		
ACGR														1						1					
SYOC						1			1	1	1	1			1			1	1		1				
AGINI																									
PF	1	1																							
QUGA			1	1	1																				
CELEL								1																	
LR													1			1	1					1	1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
SYOC	0	0	26	15	5	0	0	46
ACGR	0	0	0	0	0	0	7	7
ARTRT	0	0	0	0	2	0	0	2
JUOS	0	0	0	0	0	C	1	1
QUGA	0	0	0	0	3	0	1	4
CELEL	0	0	0	0	0	0	2	2
RIBES	0	0	0	1	0	0	0	1

TRANSECT NUMBER - 7

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
BRTET	1	1	1														1		1			1	1		1
BERE				1	1																				
QUGA						1	1	1	1	1	1														
RIBES												1													
SYOC													1												
ATCA																1									
AF																				1					
JUOS																									
POA																									
BG														1											
LR															1			1			1			1	

VEG SPECIES CODE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
BRTET	1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
BERE																									1
QUGA																									
RIBES																									
SYOC																									
ATCA																									
AF																									
JUOS						1																			
POA																								1	
BG																									
LR			1																						

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
				HEIGHT CLASSES				
QUGA	0	0	16	0	6	6	0	30
RIBES	0	0	0	0	2	0	0	2
SYOC	0	0	0	C	3	[illegible]	0	3

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
AMUTU	0	0	0	0	2	0	0	2
ATCA	0	0	3	0	0	0	0	3
JUDS	0	0	0	0	0	0	1	1

TRANSECT NUMBER - 8

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
PG	1																					1																												
JUDS				1		1	1																																											
RIBES																																									1	1								
SYOC					1				1														1	1											1					1			1							
AGROP								1																																										
ACGR																												1	1																					
AGINI										1	1					1																																		
BRTET												1			1			1													1					1														
BERE																	1																1																	
ARTRT																				1	1													1												1	1		1	1
DECA																									1					1																				
QUGA																											1																							
LR		1	1										1	1					1							1						1					1	1	1					1	1			1		

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
ARTRT	0	0	2	14	5	0	0	21
SYOC	0	3	13	0	1	0	0	17
JUDS	0	0	0	6	2	0	1	9
QUGA	0	0	1	1	1	0	5	8
ACGR	0	0	0	0	4	0	0	4
RIBES	0	0	0	3	0	0	0	3

TRANSECT NUMBER - 9

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
SALIX																																											1	1						
POA	1	1				1																																												
PF					1																																													
PG							1																																											
ACPIM								1																																										
																1	1				1	1			1	1								1	1	1			1	1	1						1			1

CEMOM																		1																																
RIBES																							1																											
SYOC																								1						1																				
AF																												1														1								
MOSS																																	1																	
BG																																1													1					
LR			1	1					1	1	1	1	1	1	1				1	1							1		1		1						1	1								1		1	1	

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
	HEIGHT CLASSES							
CEMOM	0	0	0	0	1	0	0	1
RIBES	0	0	0	0	1	0	0	1
SYOC	0	0	10	5	0	0	0	15
SALIX	0	0	0	0	0	5	0	5
POAN	0	0	0	0	0	7	0	7

TRANSECT NUMBER - 10

HIT NUMBER

VEG SPECIES CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
AGROP																																			1											1				
PF		1	1																																															
PSMEM							1	1																																					1					
SYDC										1																		1			1																			
CEMOM													1																																					
QUGA																1		1		1		1	1	1																										
BERE																																												1						
AF																																															1		1	
LR	1			1	1	1			1		1	1		1	1		1		1		1				1	1	1		1	1		1	1	1		1	1	1	1	1	1	1	1					1		1

SHRUB HEIGHT AND DENSITY

SHRUB SPECIES CODE	0-10CM	11-30CM	31-50CM	51-100CM	1-2M	2-4M	OVER 4M	TOTAL
	HEIGHT CLASSES							
SYOC	0	9	15	0	0	0	0	24
CEMOM	0	0	0	0	0	0	1	1
PSMEM	0	0	1	2	0	0	0	3
QUGA	0	0	5	9	1	0	1	16
JUOS	0	0	0	0	1	0	0	1