Section 2.04.10
Vegetation Information
New Horizon 2 Mine Area

Table of Contents

Section 2.04.10

Vegetation Information

List of Tables

List of Attachments

List of Maps

Section 2.04.10

Vegetation Information
New Horizon 2 Mine Area

1.0 Introduction

Western Fuels Colorado, A Limited Liability Company (WFC) is renewing Permit No. C-81-008. WFC's New Horizon 1 & 2 Mine is the old Peabody Coal Company Nucla & Nucla East Mine which operated under the same permit. Peabody performed detailed vegetation studies at the New Horizon 1 & 2 mine areas (formerly called the Nucla and Nucla East mine areas respectively). Rather than duplicate large quantities of vegetation data, WFC refers the reader to the original Peabody permit application: Volume D - Tab 10. When a reference is made to data sources in the Peabody documents, the word "Peabody" will immediately precede the reference.

Vegetation baseline studies were conducted on properties associated with WFC's New Horizon 2 mine as well as a larger study area (Map 2.04.10). These baseline studies were conducted during the 1987 field season and primarily involved Peabody personnel. Preparation of a detailed species list and evaluations for the potential occurrence of rare, threatened, or endangered plant species was conducted by Dr. David Buckner of ESCO Associates, Inc. The approximately 618 acre study area covers substantially more acreage than the proposed permit area in anticipation of future mine expansion to the west. The study area is used for various types of agricultural production and support, with irrigated hay, pasture, and crops providing the basis for this production. In 1999, additional vegetation baseline studies were undertaken by Intermountain Resource Inventories Inc. (IRI), Jim Irvine principal investigator. These studies verified and expanded upon studies conducted in 1987 and included land not previously survey in the original baseline vegetation study. Land studied in 1987 and 1999 includes the Morgan Property south of BB Road. Land studied in 1999 includes the Johnson, Lloyd, Benson, WFC, Guire and Martin Properties north of BB Road.

2.0 Study Area Description

2.1 Location. The study area is located in western Montrose County on the western edge of the town of Nucla, Colorado. Major cities located in relation to Nucla are Montrose, 45 air miles east-northeast and Grand Junction, 57 air miles north. The remoteness of the location is evidenced by the several hours required to reach Nucla by vehicle from the above cities.

First Park, a mesa-like landform on which the study area is located, is approximately ten miles southwest of the Uncompahgre Plateau. In earlier times First Park was referred to as Tabequache Park, a sagebrush and pinyon-juniper dominated landscape historically used by the Ute Indians and later by ranchers running livestock on open range.

The study area for 1987 and 1999 includes portions of the following sections:

Section 6, T46N, R15W
- NW¼
- W½NE¼
- W½SE¼NE¼
- W½NE¼NE¼
- N½NE¼SW¼
- Portions of N½SE¼

Section 1, T46N, R16W
- NE¼NE¼SE¼
- NE¼
- W½NW¼

Section 36, T47N, R16W
- S1/2SW1/4
- SE1/4

Section 31, T47N, R15W
- S1/2SW1/4

2.1 Geology and Soils The general landform in the Nucla area is a result of the Nucla Syncline, a northwest trending geologic structure containing the coal reserves in the study area. This shallow, broad syncline is a simple fold with gently dipping flanks. The Cretaceous-age Dakota sandstone is the youngest formation found in the study area, excepting Quaternary deposits. The Dakota formation consists primarily of resistant yellowish to gray fissile sandstone, and conglomeratic sandstones interbedded with dark gray carbonaceous shales, impure coal, and a basal conglomerate. It forms resistant but thin sandstone ledges that are scattered throughout the study area. These ledges are often exposed at the surface or are encountered within a few feet of the surface. Quaternary age deposits, which are also present in the study area, consist of wind deposited material, stream lain alluvium, and local slopewash. See Section 2.04.6, Geology Description for a more detailed discussion of the geology for the study and surrounding areas.

2.2 Soil - 1987 The dominant soils within the study area are the Barx, Progresso, Bond, Bowdish, Lazear, Travessilla, and Pinon (sic) series. Also included are large areas of Haplaquolls (no series names assigned). The Barx, Progresso, and Bond series are the predominant cropland soils and were originally dominated by sagebrush-grassland native vegetation prior to cultivation. The Barx series consists of deep well drained sandy loam soils on flat to gently sloping uplands formed in alluvium derived from sandstone. The Bond and Progresso series consist of shallow to moderately deep well drained sandy loam soils on uplands formed in alluvium derived from sandstone. Mixed with the above soils are smaller inclusions of Lazear and Bowdish sandy clay loams. These upland soils are shallow to moderately deep, well drained, and were formed in residuum derived from sandstone and interbedded shales. The Travessilla and Pinon channery sandy loam soils occur on uplands that cannot be cropped or irrigated because of rock outcrops, shallow soils, and topography. These areas have a sagebrush-grass/forb vegetation cover, but the original native vegetation was dominated by pinyon-juniper with associated understory shrubs and herbaceous species. The Travessilla and Pinon channery sandy loams are shallow to very shallow well drained soils formed from sandstone. In terms of agriculture, the latter two soils are the poorest in the study area. Other soils found on the study area include the Haplaquolls (no series name assigned). These are poorly drained shallow to deep soils and range from silty clay loams to sandy loams. They have formed in alluvium from recently deposited sediments in minor intermittent streams, sloughs, flood plains, and seepy areas below areas of ground water discharge. The Haplaquoll soils would most probably not be represented in the area if not for the large amounts

of supplemental water provided by irrigation activities. See Section 2.04.9, "Soil Resources Information," for a detailed soils discussion.

2.3 Soil - 1999 In 1998 a new Order I Soil Survey was conducted by Intermountain Resource Inventories Inc. (IRI), Jim Irvine principal investigator. The survey covered lands and properties outlined in the beginning of this chapter.

Soil consisted of 8 soil map units with a total of 10 soil types. Soil ranged from deep to shallow with underlying bedrock being soft to hard. Deeper soils formed in aeolian deposits and underlying residuum. Moderately deep to shallow soils formed in residual parent material. Barx soil is predominantly in hayland or irrigated pastures. Bowbac, Bowdish and Darvey soils are predominantly irrigated pasture with some haylands. Begay, Monierco, Valleycity, and Wahweap soil are shallow and are predominantly support sagebrush types and some low productivity irrigated pasture. See Section 2.04.9, "Soil Resource Information," for a detailed soils discussion.

2.4 Climate. The Nucla area is characterized by interior continental weather patterns resulting in a semiarid climate. Precipitation is scattered throughout the year, though the highest amounts are received during the summer months. Snowfall does not normally contribute significantly to the yearly totals received. For the years 1961 through 1975, the Uravan Station recorded average annual precipitation of 12.24 inches. Average annual precipitation at Uravan for the year 1978 through 1986 was 14.38 inches, indicating a wetter precipitation cycle at this time. Table 2.04.10-1 details the precipitation received at the Uravan Station, located 13 miles northwest of Nucla, for the months January through October in 1987 and January through April 1999.

Temperatures in the Nucla area are generally moderate throughout the year, though summers can be hot. The average annual mean temperature for the Uravan Station is 48°F. Table 2.04.10-2 presents temperature data from the Uravan Station for the months January through October in 1987 and January through April 1999. May through August 1999 showed much higher rainfall than average with most stations in western Colorado reporting precipitation more than 178% of normal.

The semiarid climate, with sunny days predominating and low relative humidities, results in high evapotranspiration rates. The frost free period is approximately 150 days. Further information on climate may be found in Section 2.04.8, Climatological Information.

Table 2.04.10-1

Precipitation Received For the Months January Through October, 1987 and January Through April, 1999 at the Uravan, Colorado Station

	Precipitation (inches)	
Month	**1987**	**1999**
January	1.60	0.04
February	1.26	0.46
March	1.39	0.02
April	0.41	2.68
May	1.81	
June	0.04	
July	1.56	
August	3.30	
September	0.51	
October	1.48	
Totals	**13.36**	**3.20**

Source: NOAA 1987.

Table 2.04.10-2

Monthly Average Temperatures With Maximum/Minimum

Values For The Months January Through October, 1987

Recorded At The Uravan, Colorado Station

	Temperature (°F)					
Month	**Average**		**Average Max.**		**Average Min.**	
	1987	**1999**	**1987**	**1999**	**1987**	**1999**
January	26.7	34.6	39.8	49.7	13.5	19.5
February	36.5	37.9	48.2	54.3	24.8	21.4
March	40.5	47.5	54.1	67.1	26.8	27.9
April	54.1	45.8	71.5	60.9	36.6	30.7
May	60.9		75.7		46.0	
June	74.1		92.0		56.2	
July	75.1		94.3		55.8	
August	72.8		89.0		56.6	
September	65.0		84.7		45.3	
October	56.2		74.8		37.5	

Source: NOAA 1987.

3.0 Vegetation and Land Use Overview

Note: For the 2006 Mid Term Review and the Permit Revision #6 for 2009, pre-mine vegetation types have been classified according to the listings in Rule 1.04 and Map 2.04.10 has been revised to show these re-classifications. No changes to the original study have been made, however, in order to follow the many pages of discussion of all the vegetation areas, the following classification changes are helpful.

- Swale Drainage areas are now listed as Pastureland - Irrigated - Swale. (Map symbol IPSW)
- Ponds are called Developed Water Resource - Ponds (Map symbol P)
- There are no Facility areas and there were none in the original studies.

- Orchards have been re-classified as Cropland - irrigated orchards (Map symbol ICO)
- Croplands have been re-classified as Croplands - irrigated alfalfa hay (Map symbol IC)
- Small grain croplands have been given a classification as Croplands - Small Grains (Map symbol ICSG)
- Irrigated Hayland has been re-classified as Irrigated Pasture - Hayland (Map symbol IPH) since the management of these areas did not qualify these areas to meet the intensity required for classification as Irrigated Cropland in addition to soils that are not optimum.
- Irrigated Pasture (Map symbol IP) has not changed.
- Sagebrush (Map symbol SG) has not changed. It is a sub category under Rangeland.
- Sagebrush 1 (Map symbol SG-1) has not changed. It is a sub category under Rangeland.
- Sagebrush 2 (Map symbol SG-2) has not changed. It is a sub category under Rangeland.
- Floodplain (Map symbol FP) has not changed. It is a sub category under Rangeland.
- Deciduous Trees (Map symbol DT) has not changed. It is a sub category under Rangeland.
- Farmsteads (Map symbol F) has not changed. It is a sub category under Residential Use.
- Existing Disturbed lands have now been called Residential - Open Space Disturbed Areas (Map symbol D)

No boundaries of these land use areas have been changed; only the classification categories to comply with Rule 1.04. Map 2.04.10 also has the aerial photography from 1998, where mining was active southeast of the intersection of 2700 Road and BB Road, near Pond 007. This aerial shows details of much of the pre-mine land use and vegetation. The categories shown Map 2.04.10 are the same as those shown on Map 2.04.3 Pre-Mine Land Use.

We believe that one area of former Irrigated Hayland should be classsified as Irrigated Cropland on the Morgan property due to consistent baling of hay and good soils, as well as the NRCS determination of 2008. On the other hand, two areas of irrigated cropland (25.06 acres) that are shown on Map 2.04.3, which were mapped in 1987 as Irrigated Cropland immediately north and west of Pond 7 have been determined to be Irrigated Cropland - Small Grains (ICSG) instead. This is due to poor soils (See Section 2.04.9) and the fact that most of this land is on the Burbridge property and he did not manage it intensively. According to the 1987 study, theses fields were not tilled after harvest the previous year and were allowed to volunteer barley and a host of annual and perennial weedy species. Map 2.04.3 Pre-Mine Land Use has been altered to reflect the more accurate characterization of the ICSG land.

The natural vegetation occurring in the Nucla area has been described by Kuchler (1964) as the Juniper-Pinyon Woodland Type and the Great Basin Sagebrush Type, while Brown, et al. (1980) classified the natural vegetation communities as the Pinyon-Juniper Series of the Great Basin Conifer Woodland Biome and the Sagebrush Series of the Great Basin Desertscrub Biome. While these natural vegetation types are obvious in the surrounding undisturbed native rangelands, over 100 years of intensive agriculture on First Park has resulted in only scattered remnants of these native vegetation types in areas where soils are too shallow or irrigation water could not be applied. Prior to agricultural conversion sagebrush shrublands occupied the park-like areas with deeper soils and more gentle slopes while the more broken upland areas with shallow coarse textured soils were occupied by the pinyon-juniper woodlands. Since deeper soils are common in the study area, the sagebrush shrubland was probably the predominant vegetation in the native landscape. Western settlers desiring to convert native rangeland to agricultural ground, selected areas dominated by sagebrush because these areas contained the deeper more desirable soils and more gentle slopes.

The incorporation of the Colorado Cooperative Company in 1894, completion of the Colorado Cooperative Ditch in the early 1900's, and establishment of the Nucla community during the same period were the driving forces resulting in the change from the semiarid natural vegetation types to lands dedicated to irrigated agricultural production. The present landscape and land use on First Park, and Second Park to the north across Tuttle Draw, reflects years of development and management for irrigated hay, pasture and crop production. The irrigation system reflects the typical mountain-type flood irrigation systems using gravity flow ditches, laterals, and cut-outs to insure coverage over the irregular topography. Though the system is inefficient in terms of irrigation water application and is dependent on large inputs of manpower, adequate water supplies, intensive efforts by managers and reuse of water by downfield operators has insured adequate production on the lands. Levels of production vary greatly with the amount and degree of management inputs. Deeper soils on landforms that are less steep and more uniform enhance irrigation water management with consequent benefits to production.

Agricultural production is concentrated on irrigated hayland and irrigated pasture. Irrigated cropland, at a lesser acreage than the previous two uses, is generally devoted to the production of alfalfa and corn silage. The reduced contribution of cropland to the overall

acreage is a result of terrain, shallow soils, and the need of a hay base for livestock. Livestock operations, both cattle and sheep, are important in the area. The irrigated hayland and pasture resources provide hay base and winter feeding areas for herds that are run on adjacent private, Bureau of Land Management (BLM), and Forest Service (USFS) rangeland during the spring, summer, and fall months. In years past, orchard production was important as evidenced by the number of abandoned orchards remaining in the area. Irrigated haylands are primarily composed of alfalfa and various complimentary grasses such as orchardgrass and smooth brome. Irrigated pastures are composed of a myriad of species, both desirable and undesirable, due to irregular irrigation water application, lack of periodic tillage and pasture renovation, low levels of management, and overuse. Swale, bog, or riparian areas have developed in some areas as a result of irrigation water runoff (irrigation tailwater). All of these areas have been classified in the pre-mine land use tables as irrigated pastureland, since almost all of them receive runoff from irrigated croplands or pastures but are not harvested or baled. Additionally, ground water recharged from irrigation, discharges at a number of downslope areas as seeps and bogs. These are very minor in area. There was no true dryland pasture in the pre-mine land use. All dry areas that had vegetation were either some type of sagebrush dominated rangeland or pinon juniper community. Minor sagebrush dominated native rangeland areas generally have been included in pastures that have had intensive livestock use. This has resulted in an overstory of woody species and an understory of undesirable annual and perennial weedy species. The original pinyon-juniper overstory in these areas has essentially been removed. With the continued availability of adequate irrigation water, irrigated pastureland, and cropland, including irrigated alfalfa hay, corn silage, and various other crops will continue to dominate the landscape around Nucla.

4.0 Vegetation Baseline Sampling Methods

The presence of specific vegetation types and communities resulting from intensive agricultural land use and irrigation dictated unique approaches to vegetation baseline sampling within the study area at the proposed New Horizon 2 Mine. Surface mining operations normally occur on native rangelands in the Western U.S., and only rarely involve agricultural lands. General discussions on sampling methodologies and intensities, as well as vegetation type delineations, were carried out with representatives of the Office of Mined Land Reclamation (OMLR) beginning in February 1987. A letter to the OMLR on June 15, 1987 detailed Peabody Coal Company's (Peabody) proposed sampling program for the New Horizon 2 study area. Included in the letter were approximate acreages for the various vegetation or agriculture types and accompanying detailed descriptions of the types and the natural and manmade conditions controlling their expression on the landscape. Sampling parameters and intensity were also proposed in the letter. The OMLR response to this proposal was received on August 11, 1987 and specified concurrence for the sampling techniques proposed for the Irrigated Hayland Type, Irrigated Cropland Type, and the Farmstead, Facilities, Orchards, etc. Questions were raised as to why all parameters (i.e., production, cover, woody plant density) were not sampled for the Irrigated Pasture Type, as well as concern for a lack of adequate sampling intensity in the Swale/Drainage and Rangelands Types. On August 20, 1987 Peabody responded to the OMLR's comments and concerns and provided clarification on several items. Peabody agreed to increase sampling intensity in the Swale/Drainage Type and provided a discussion supporting justification for using ocular cover estimates versus point-intercept cover measurements in the type. Justification for a sampling intensity of 30 samples in the Rangeland Type was also provided in the August 20 letter. It was also brought to the OMLR's attention that the cropland areas within the study area were not going to be cropped during the 1987 growing season. On September 3, 1987 the OMLR responded to Peabody's August 20 correspondence, concurring with the requested sampling intensity in the Rangeland type and the change in cover sampling methodology for the Swale/Drainage Type. Based on the OMLR's comments on the Irrigated Pasture, Peabody completed sampling for all parameters in the type.

The issue of reference areas was addressed in both Peabody's and the OMLR's correspondence. It was Peabody's opinion and is WFC's opinion that adequate reclamation

success standards can be developed without the use of reference areas with the exception of dryland pasture. Baseline sampling during the 1987 field season reconfirmed the great variation in management objectives of individuals and the highly diverse nature of the soils, geology, and ground and surface water regimes. In many cases the management plans of operators (both within and adjacent to the study area) changed weekly. This occurred even on lands where Peabody had a reasonable level of control. Crop rotations or pasture and hayland renovation could easily eliminate or change the nature of a reference area at the time of bond release evaluations. Personal management objectives and methods are highly variable for the various landowners or lessees. Irrigation water management, fertilization programs (if any), harvest period, hay/pasture management, cropping, and grazing management were different for nearly all landowners contacted. The end result of the above is a situation of no guarantees. Guarantees of long term and somewhat consistent management are a critical element that must be reasonably assured when using reference areas. Therefore, Peabody has developed alternate reclamation standards as allowed for under 4.15.7(d) of the Regulations. These standards are discussed in Section 2.05.4(2)(e), Revegetation.

For the 1999 vegetation baseline studies, sampling procedures were used that corresponded with those agreed upon in the 1987 permit for sampling sagebrush, irrigated pasture, irrigated hay, and swale/ drainage. In addition, three other plant communities occur in the proposed permit expansion boundary but are outside the area of disturbance. These areas were agreed to be described in a qualitative narrative. These communities are the flood plain of Tuttle draw, a small area of deciduous trees fed by irrigation water on a north facing mesa side slope of the Martin Property and a small area of Pinon and Juniper on a north facing mesa side slope of WFC property.

Table 2.04.10-3 summarizes sampling parameters and intensities for the various types in 1987. Table 2.04.10-3A summarizes sampling parameters and intensities for the various types in 1999. Details of sampling methods are provided following this summary. Data Sampling Summary results are in Attachment 2.04.10-3 Sampling Data Summary.

Table 2.04.10-3A
Sampling Parameters and Intensities for the Vegetation Types Found in the Nucla East Study Area, 1987

Vegetation Type	Parameters	Sample Size[1] Minimum	Maximum
Irrigated Pasture	Production	15	50
	Cover	15	50
	Woody densities	Direct count from aerial photos/field checks.	
Irrigated Pasture Hayland	Production	See sampling methods discussion	
Irrigated Cropland	Production	See sampling methods discussion	
Swale/Drainage	Production	15	50
	Cover	15	50
	Woody densities	15	50
Sagebrush	Production	15	30
	Cover	15	30
	Woody densities	15	30
Farmsteads, abandoned orchards	Qualitative descriptions with discussion on potential plant communities based on SCS range site descriptions		

[1] A minimum of 15 observations were collected in the samples prior to testing for sample adequacy. A maximum of 50 observations, depending on the vegetation type, were collected if sample adequacy could not be achieved prior to reaching the maximum sample sizes.

Table 2.04.10-3B
Sampling Parameters and Intensities for the Vegetation Types Found in the New Horizon 2 Permit Expansion Study Area, 1999

Vegetation Type	Parameters	Sample Size[1] Minimum	Maximum
Irrigated Pasture	Production	15	50
	Cover	15	50
	Woody densities	15	50
Irrigated Pasture Hayland	Production	See sampling methods discussion	
Irrigated Cropland	Production	See sampling methods discussion	
Swale/Drainage	Production	15	50
	Cover	15	50
	Woody densities	15	50
Sagebrush (SG-1)	Production	15	50
	Cover	15	50
	Woody densities	15	50
Sagebrush (SG-2)	Production	15	50
	Cover	15	50
	Woody densities	15	50
Original Sagebrush Reference	Production	10	30
	Cover	10	30
	Woody densities	10	30
Dryland Pasture Reference	Production	15	50
	Cover	15	50
	Woody densities	15	50
Pinon-Juniper	Qualitative descriptions		
Deciduous Trees			
Flood Plain			

[1] A minimum of 15 observations were collected in the samples prior to testing for sample adequacy. A maximum of 30 to 50 observations, depending on the vegetation type, were collected if sample adequacy could not be achieved prior to reaching the maximum sample sizes.

4.1 Vegetation Mapping - 1987 A blueline print of a single-frame black and white aerial photograph of the study area at a scale of 1" = 400' was used as the base for mapping vegetation. Stereo-paired color and false-color infrared aerial photographs at a scale of 1" = 500' were used to assist in photo interpretation and delineating map unit boundaries on the base map. The map unit delineations were refined with ground inspection while conducting the field sampling activities. Mapping units were based on the vegetal type classifications previously identified.

The acreage of the various vegetation types were determined from the refined base map using a Calcomp 9100 electronic digitizer. The digitizer is linked to an IBM (XT) personal computer equipped with the appropriate software to calculate area from the digitized data. Each map unit was digitized and the resulting areas summed for the corresponding vegetation types to calculate total acreages.

4.2 Vegetation Mapping - 1999 In 1999 a 1:2133 scale color aerial photo was scanned at 600 dpi and used as a background to digitize map unit boundaries in AutoDesk AutoCAD R14. The resultant drawing was then imported into Arc/INFO to obtain map unit acreage. The map was then refined and verified in the field and final map unit acreage calculated.

As required under 2.04.10(3) vegetation mapping was carried out in a sufficiently large adjacent area to allow for evaluation of wildlife habitat. In this case the adjacent area encompassed 1/2 mile outside of the proposed mine permit expansion. Since this relates to wildlife habitat, it has been included on Map 2.04.11-1, Wildlife Habitats and Sampling Sites Map. The completed vegetation map including 1987 and 1999 vegetation mapping efforts is presented as Map 2.04.10.

4.3 Floristics - 1987 A comprehensive plant species list was developed from floristic surveys conducted by Dr. David Buckner of ESCO Associates, Inc. The floristic surveys were completed in late June and early August, 1987 by conducting a walking reconnaissance of the study area and noting species occurrence and distribution in the various vegetation types. The floristic surveys were augmented with species lists prepared by Peabody's Environmental Scientists while conducting the quantitative vegetation studies.

Prior to conducting the floristic surveys, records of the Colorado Natural Areas Inventory (CNAI) database (Colorado Natural Areas Program) were checked to ascertain the potential occurrence of rare, threatened, or exemplary plants and plant communities in the New Horizon 2 study area. Care was taken during the floristic surveys to thoroughly search each vegetation type for plant species that are listed or proposed for listing as threatened, endangered, or exemplary in Colorado.

The comprehensive plant species list was organized for reporting purposes by morphological class; i.e., annual or perennial graminoids, annual or perennial forbs, shrubs and subshrubs, trees, succulents, vines and aquatics. Each taxon was further identified by scientific binomial, common name, origin, and habitat occurrence. Taxonomy and nomenclature followed Weber (1987), Hermann (1975), and Hermann (1970). Beetle (1970), Nickerson et al. (1976), and SCS (1979) were consulted in an effort to apply the most widely accepted common names.

4.4 Floristics - 1999 The original 1987 floristic survey was updated and augmented as species were encountered during sampling and during extensive field reconnaissance of the area. Similarly, care was taken during the floristic surveys to thoroughly search each vegetation type for plant species that are listed or proposed for listing as threatened, endangered, or exemplary in Colorado. Nomenclature for species added to the floristics list is that used by the NRCS PLANTS database of plants in the US.

4.5 Sample Point Selection - 1987 Individual sample point locations, and line or belt transect origins were selected using pairs of randomly-generated numbers. Pairs of random numbers, treated as Cartesian coordinates, were plotted on x and y axes drawn on the base map until a sufficient number of points were located in each vegetation type to achieve the desired maximum samples sizes required. Randomly-generated numbers were also used to define the compass direction at which the line or belt transects would be oriented from the origin. The random numbers generator in a Hewlett-Packard 11-C hand-held calculator was used to generate the coordinate pairs and compass bearings.

The sample point locations, and line or belt transect origins were located on the ground by pacing the required distances and directions from recognizable landmarks on the base map such as fence lines, corner posts, road intersections, and building corners. Once the vicinity of the sample point was found, a stake was thrown over the observers shoulder to identify the exact location where the sampling point would be located.

4.6 Vegetation Cover and Frequency - 1987 Quantitative measurements of vegetation cover and plant species frequency were made in the sagebrush, irrigated pasture and swale/drainage vegetation types.

Vegetation cover data was collected in the sagebrush type by the point-intercept technique applied by use of an optical point bar (Mueller-Dombois and Ellenberg 1974; Viert 1985; Buckner 1985). The data was collected on July 9 and 10, 1987. The sampling design consisted of groups of ten points sampled at 2m intervals along a 20m transect to achieve 100 points per transect. Thirty transects were sampled. Each group of ten points, with a 10cm interval between each point, was oriented perpendicular to the transect such that five points were projected vertically downward (or upward for overhanging canopy) on each opposing side of the transect. At each point, the first contact of a plant species was recorded as a "hit". In cases where vegetation was not contacted, either bare ground (soil), litter, or rock hits were recorded. Each hit represented one percent cover for a transect. For example, a plant species that was contacted 15 times on a transect had an estimated cover of 15 percent for that particular transect ((15/100) x 100). Since the points were situated systematically along the randomly-located transects, each transect (i.e., 100 data points) represented an observation in the sample. Therefore, the estimated mean cover for a particular species in the vegetation type as a whole was derived by summing the percent cover measured on each transect and dividing by the total number of transects sampled.

The point-intercept technique was also used to collect vegetation cover data in the irrigated pasture type, although the sampling design was modified to accommodate the inherently greater cover found in the type as compared to that encountered in the sagebrush. The samples were collected on September 15 and 16, 1987. The sampling design consisted of 25 pairs of points, sampled at 1m intervals along a 25m transect to achieve 50 points per transect. A minimum of 15 transects, distributed throughout the type, were sampled. The two

points constituting a pair were spaced 1m apart on opposite sides and perpendicular to the transect. The points were projected vertically downward (or upward if overstory canopy occurred) to record first hit cover of vegetation, rock, litter, or bare ground (soil). Percent cover by plant species, or soil, litter, or rock was calculated by dividing the number of hits on each by the total number of points sampled per transect and expressing the result as a percentage. For example, a species with 2 hits on a transect had a cover of 4 percent ((2/50) x 100). The estimated mean cover for a particular constituent in the vegetation type as a whole was derived by summing the percent cover measured on each transect and dividing by the total number of transects sampled.

Vegetation cover data was collected in the graminoid component of the swale/drainage type using plots and ocular estimates (Cox 1976). The graminoid component comprises approximately 80 percent of the swale/drainage type in the study area and consists of extensive tracts of hydrophytic graminoids surrounding isolated monotypic islands or stringers of cattail. The cattail islands and stringers range from less than 0.1 acres to approximately 2.0 acres in size. The data was collected on July 21 and 22, 1987. At each randomly-located sample point, a single 50 x 50cm plot ($0.25m^2$) was used. A total of 30 plots were sampled. Ocular estimation involved observation of the vegetation, litter, rock, and bare ground from a vertical perspective within the plot boundaries. The plots were marked with 10cm, 5cm, and 2.5cm divisions to facilitate estimates of percent coverage. The cover estimates considered the actual area covered by a particular constituent rather than cover classes or close-fitting polygons, to obtain an estimate of absolute or foliar cover. The estimated mean cover for a particular constituent in the type was derived by summing the cover estimates in each plot and dividing by the total number of plots sampled.

The remainder of the swale/drainage type consists of a scrub/shrub component dominated by virtually impenetrable thickets of willow. The thickets comprise approximately 20 percent of the swale/drainage type, existing as islands or stringers of vegetation within the graminoid component. The majority of the islands and stringers of willow range in size from approximately 0.1 to 0.25 acres. One stand, located in swale/drainage vegetation on the west side of the proposed permit area is larger (approximately 2.5 acres in size). Only qualitative estimates of herbaceous and shrub cover were made in this component due to its inherent in

measurability and the lack of pertinent information that would be achieved from quantitative sampling attempts.

Peabody originally intended to use the point-intercept technique to measure cover in the swale/drainage type. However, after utilizing the method in the field it became apparent that the technique was inappropriate for use in the swale/drainage vegetation. The reasons for this are related to the type of vegetation, the morphology of the plants, and the structural complexity of the herbaceous foliage. Primarily, the predominance of a rather tall and densely intermingled stand of graminoids with long narrow stems, and a very heavy litter component in the foliage contributed to the problem. The end result was that the observers were unable to accurately determine the identity of the vegetation being contacted, or in cases where vegetation was encountered deep within the canopy, whether a hit was indeed registered. Shadowing within the canopy very nearly precluded any accurate observations even during mid-day. When a hit could be registered, it usually required a thorough investigation through the foliage to ascertain the species intercepted. The sorting through the canopy tended to disturb the surrounding vegetation, thereby biasing adjacent point projections. With these problems noted, alternate sampling methodology was selected (ocular estimates) which proved more satisfactory. Concurrence with the change was obtained from the OMLR via letter correspondence dated September 3, 1987 from Mr. Peter O'Connor to J. Lunan of Peabody.

Plant species frequency or presence was derived by dividing the number of plots or transects at which a species occurred by the total number of plots or transects sampled in each of the three vegetation types for which cover samples were obtained. Products were multiplied by 100 to express frequency as a percentage.

4.7 Vegetation Production - 1987 Quantitative measurements of vegetation production were made in the sagebrush, irrigated pasture, graminoid component of the swale/drainage, and irrigated hayland vegetation types.

Prior to the spring growing season in 1987, grazing exclosures were installed in the sagebrush, irrigated pasture, and graminoid component of the swale/drainage types. Fifty randomly-located sample points, protected by grazing exclosures were located in the irrigated pasture

type. Thirty protected sample points were randomly located in the sagebrush and swale/drainage types (graminoid component). The grazing exclosures were designed in the shape of a cone with a circular base that exceeded 1m in diameter. The exclosures were constructed with four-inch mesh woven wire and were anchored in the ground with rebar. The cages remained in place until the production samples were collected.

With the exception of the graminoid component of the swale/drainage type, all production data was collected concurrently with measurements of vegetation cover and frequency. The 30 original enclosed plots in the swale/drainage areas were sampled concurrently with the cover and frequency data as well. However, ongoing negotiations with the OMLR regarding sampling intensity in the type, and the lack of achieving sample adequacy with 30 observations necessitated further sampling. The additional samples were obtained in mid-August from 21 randomly-located plots that had not been protected from grazing. This inconsistency was determined not to be a problem since little or no livestock utilization was observed in the swale/drainage type. In fact, the modified study design prescribed that randomly-located plots in which any indication of utilization was detected would be discarded for sampling purposes. However, no such plots were encountered. The range in sampling dates (approximately 30 days between the dates of the two samples) did not introduce significant temporal variation in the overall sample since most of the vegetation was in a post-reproductive (maintenance) growth phase during the interval between samples. No attempt was made to sample production in the willow component of the swale/drainage primarily because of immeasurability.

Measurements of above-ground plant biomass were made using a 0.25m² circular plot in both the graminoid component of the swale/drainage and irrigated pasture types. A 1.0m² plot was used in the sagebrush type. Within each production plot, all green, living herbaceous plant material was clipped as close to ground level as possible, separated by lifeform (annual forbs, annual graminoids, perennial forbs, and perennial graminoids), immediately weighed using Pesola field scales, and bagged for laboratory analysis. Herbaceous plant material was not sorted in the irrigated pasture samples. In the laboratory, samples were oven-dried at 30°C in a forced draft oven for 72 hours, or until a constant weight was obtained. Dry weights were obtained on an Ohaus top-loading electronic balance which is accurate to the nearest 0.01 gm.

Production sampling methods for the irrigated hayland vegetation type at the New Horizon 2 study area were developed specifically for the conditions expected (i.e., variable management applications including stand reconditioning, aftermath grazing, the number of cuttings, and fertilizer applications), minimal operational impacts to land owners during sampling, and the lack of appropriate county average yield data. Concurrence with the methodology was obtained from the OMLR by letter correspondence from Mr. Peter O'Connor to J. Lunan (Peabody) dated August 7, 1987. The production sampling method for irrigated haylands is described below.

Upon completion of any hay cutting and baling operation in any irrigated hayland field, a count of the total number of bales per field was made. Next, an adequate sample of the bales in each field was weighed in the field using a Fairbanks Model 41-3132 portable scale. This scale has a maximum capacity of 1,000 pounds and is accurate to the nearest pound. A minimum of 15 bales were weighed in each field. Care was taken to select bales from throughout a field, or in cases where the bales had already been stacked, from many locations in the stack. At the time of weighing, sub-samples of hay were collected from a portion of the bales, weighed using Pesola field scales, bagged and labeled, and returned to the laboratory for analysis. In the laboratory, sub-samples were dried at 30°C for 72 hours, or until a constant weight was obtained, and reweighed using an Ohaus top-loading electronic balance which is accurate to 0.01 gm. This provided an adjustment factor needed to determine dry weight production for the fields. The hay production in the fields, expressed on a dry weight basis as pounds/acre, was calculated by multiplying the total number of bales counted in a field by the average adjusted bale weight and dividing by the size of the field in acres.

Peabody intended to measure production in the irrigated cropland type by weighing loaded trucks (which had been tared) during the harvest season. However, yield data could not be collected during the 1987 sampling season because the majority of fields were left fallow or allowed to volunteer through the cropping season. A single field in the western portion of the study area was planted to wheat, but the landowner decided not to attempt a harvest because the yield was too poor to make harvesting worthwhile. Prior to maturing of the remaining grain, he grazed the crop with sheep.

4.8 Woody Plant Densities - 1987 Woody plant densities were measured in the sagebrush type and willow component of the swale/drainage type using belt transects. All trees, shrubs, sub-shrubs, succulents, and agavoids were included in the counts. A species was counted for density when at least 50 percent of the crown emerged within the belt. A 2m x 25m belt, originating at the randomly-located sample point and extending in a random direction, was used in the sagebrush type. A randomly-located 0.5m x 2.0m belt was used in the willow component of the swale/drainage. This small belt size was selected on the basis of the extremely dense character of the willow thickets.

Woody plant densities were measured in the irrigated pasture vegetation type using direct counts from 1" = 500' color aerial photography with field checks for verification.

4.9 Sample Point Selection - 1999 Individual sample point locations, and belt transect origins were selected using pairs of randomly-generated coordinates. The 1999 vegetation map was brought into ESRI ArcView and a state plane 100 foot interval tic grid was overlaid on the map. Coordinates located within a map unit were listed and exported to Microsoft Access where a random number generator was used to pick pairs of coordinates for sampling locations. The numbers 0 to 359 were also entered into Microsoft Access and a random number generator used to select transect direction.

Sample point locations were located from the resultant transects being plotted on the raster digital aerial photo. The observer then walked to that point using visible landmarks. Once the vicinity of the sample point was found, a orange spike was thrown over the observer's shoulder to identify the exact location where the sampling point would be located.

4.10 Vegetation Cover and Frequency - 1999 Quantitative measurements of vegetation cover and plant species frequency were made in the sagebrush - 1 (SG-1), sagebrush - 2 (SG-2), sagebrush reference area, dryland pasture reference area, irrigated pasture and swale/drainage vegetation types.

Vegetation cover data was collected in the sagebrush type by the point-intercept technique applied by use of an laser point bar. The data was collected on July 13 through 20, 1999. The

sampling design consisted of groups of ten points sampled at 10 ft. intervals along a 100 ft. transect to achieve 100 points per transect. Thirty to 50 transects were sampled. Each group of ten points, with a 10cm interval between each point, was oriented such that 10 points were projected vertically downward (or upward for overhanging canopy) perpendicular to the transect. At each point, the first contact of a plant species was recorded as a "hit". If the hit was a living perennial, the vegetation was moved to see if a subsequent perennial was “hit” and recorded separately as a second “hit”. In cases where vegetation was not contacted, either bare ground (soil), litter, or rock hits were recorded. Each hit represented one percent cover for a transect. For example, a plant species that was contacted 15 times on a transect had an estimated cover of 15 percent for that particular transect ((15/100) x 100). Since the points were situated systematically along the randomly-located transects, each transect (i.e., 100 data points) represented an observation in the sample. Therefore, the estimated mean cover for a particular species in the vegetation type as a whole was derived by summing the percent cover measured on each transect and dividing by the total number of transects sampled.

The point-intercept technique was also used to collect vegetation cover data in the irrigated pasture type, although the sampling design was modified to accommodate the inherently greater cover found in the type as compared to that encountered in the sagebrush. The samples were collected on July 13 through 20, 1999. The sampling design consisted of 10 points, sampled at 10 ft. intervals along a 100 ft. transect to achieve 100 points per transect. A minimum of 30 transects, distributed throughout the type, were sampled. The 10 points were spaced 10 cm. apart perpendicular to the transect. At each point, the first contact of a plant species was recorded as a "hit". Secondary hits of perennial vegetation was not collected as moving the vegetation disturbed the next adjacent “hit” and would have biased the outcome of first “hit” measurements. In cases where vegetation was not contacted, either bare ground (soil), litter, or rock hits were recorded. Percent cover by plant species, or soil, litter, or rock was calculated by dividing the number of hits on each by the total number of points sampled per transect and expressing the result as a percentage. The estimated mean cover for a particular constituent in the vegetation type as a whole was derived by summing the percent cover measured on each transect and dividing by the total number of transects sampled.

Vegetation cover data was collected in the graminoid and forb component of the swale/drainage type using plots and ocular estimates (Cox 1976). The graminoid component comprises approximately 95 percent of the swale/drainage type in the study area and consists of extensive tracts of hydrophytic graminoids. Cattails comprise 3 percent of the swale/drainage type and occur adjacent to stock ponds and in waste ditches and range from less than 0.1 acres to approximately 0.5 acres in size. The data was collected on July 13 through 20, 1999. In keeping with 1987 procedures, a single 50 x 50cm plot ($0.25m^2$) was used for estimating cover at randomly-located sample point. A total of 30 plots were sampled. Ocular estimation involved observation of the vegetation, litter, rock, and bare ground from a vertical perspective within the plot boundaries. The plots were marked with 10cm, 5cm, and 2.5cm divisions to facilitate estimates of percent coverage. The cover estimates considered the actual area covered by a particular constituent rather than cover classes or close-fitting polygons, to obtain an estimate of absolute or foliar cover. The estimated mean cover for a particular constituent in the type was derived by summing the cover estimates in each plot and dividing by the total number of plots sampled.

The remainder of the swale/drainage type consists of virtually impenetrable thickets of willow. The thickets comprise approximately 2 percent of the swale/drainage type, existing primarily along the CC Ditch. The majority of the willow type ranges in size from approximately 0.1 to 1 acres. In keeping with 1987 procedures, only qualitative estimates of herbaceous and shrub cover were made in this component due to its inherent immeasurability and the lack of pertinent information that would be achieved from quantitative sampling attempts.

Plant species frequency or presence was derived by dividing the number of plots or transects at which a species occurred by the total number of plots or transects sampled in each of the three vegetation types for which cover samples were obtained. Products were multiplied by 100 to express frequency as a percentage.

4.11 Vegetation Production - 1999 Quantitative measurements of vegetation production were made in the sagebrush - 1 (SG-1), sagebrush - 2 (SG-2), sagebrush reference area, dryland pasture reference area, irrigated pasture, irrigated hayland, and swale/drainage vegetation types.

In 1999 no range exclosures were present. The observer picked pastures that had not been subjected to current year grazing for sampling.

Production data was collected concurrently with measurements of vegetation cover and frequency. In keeping with 1987 procedures, no attempt was made to sample production in the cattail or willow component of the swale/drainage primarily because of immeasurability.

Measurements of above-ground plant biomass were made using a 0.25m² square plot in both the graminoid component of the dryland pasture area, irrigated haylands, swale/drainage and irrigated pasture types. A 1.0m² plot was used in the sagebrush types. Within each production plot, all green, living herbaceous plant material was clipped as close to ground level as possible, separated by lifeform (annual forbs, annual graminoids, perennial forbs, and perennial graminoids), immediately weighed using a Pesola 41002 field scale, and bagged for laboratory analysis. Shrubs were clipped of annual growth, bagged and weighed. Herbaceous plant material was not sorted in the irrigated pasture samples. In the laboratory, samples were oven-dried at 30°C in a forced draft oven for 72 hours, or until a constant weight was obtained. Dry weights were obtained on an Sartorius E8001P top-loading electronic balance which is accurate to the nearest 0.001 gm.

Production sampling methods for the irrigated hayland vegetation type at the New Horizon 2 study area were consistent with those used in 1987. Five hayland fields had been mowed and baled during the study period. These field were all first cuttings. Three fields, belonged to Morgan and two fields belonged to Johnson. All fields were mowed by Morgan and baled using his Heston 4650 Bailer. The bales measured 42 in. X 18 in. X 16 in. Morgan said dry bales consistently weigh between 85 to 90 pounds ever since he obtained the bailer.

First cutting hay bales were counted either in the field or from the stacks. Next, an adequate sample of the bales from each field was weighed using a Hanson 93490 portable scale. This scale has a maximum capacity of 200 pounds and is accurate to the nearest pound. A minimum of 30 bales were weighed from each field except for one field which had 21 bales. In that field, 10 bales were weighed. Care was taken to select bales from throughout a field, or in cases where the bales had already been stacked, from many locations in the stack. The hay production in the fields, expressed on a dry weight basis as pounds/acre, was calculated by

multiplying the total number of bales counted in a field by the average adjusted bale weight and dividing by the size of the field in acres. Additionally, clipped plots in similar irrigated pastures were used for comparison.

4.12 Woody Plant Densities - 1999 Woody plant densities were measured in the sagebrush types, dryland pasture reference area, and willow component of the swale/drainage type using belt transects. All trees and shrubs were included in the counts as outlined in CDMG "Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining". A species was counted for density if it was rooted within the belt. For all species except willow stems were traced back to their origin and counted as one plant. For example, a sagebrush plant that had 4 stems emanating from a central point was counted as one plant/stem. A 3 ft. x 100 ft. belt, originating at the randomly-located sample point and extending in a random direction, was used in the sagebrush type and dry land reference area. A randomly-located 1 square meter sampling frame was used for stem counts in the willow component of the swale/drainage. All willow stems emanating from the ground were counted as it was impossible to determine if any one stem belonged to any one plant. Fifteen samples were collected in this manner.

4.13 Sample Adequacy 1987 and 1999 The following formula was used to determine the adequacy of the quantitative cover, production, and woody density samples in the New Horizon 2 studies:

$$Nmin = (st)^2/(dx)^2$$

where,

Nmin = minimum sample size
s = sample standard deviation
t = two-tailed t-value at the 90 percent confidence interval (alpha = 0.10) with infinite degrees of freedom (t = 1.645)
d = desired level of reduction about the sample mean (0.10)
x = sample mean

In all cases, sampling was continued until the minimum sample adequacy requirements were exceeded, or the prescribed maximum number of observations were collected. Maximum

sample sizes were developed during the consultation process with OMLR staff and CDMG staff prior to and during the field studies (letter correspondence from Mr. Peter O'Connor to J. Lunan of Peabody dated August 7 and September 3, 1987), (1999 site visits with Dan Matthews and Harry Ranney, and phone conversations with Janet Binns all of the CDMG).

4.14 Livestock Carrying Capacity Stocking rates were calculated for the irrigated pasture vegetation type only using the results of production samples collected in the type. The rates were based upon the standard 27 pounds/day dry weight intake per animal unit. The rates were expressed as available forage in animal unit months (AUMs).

4.15 Species Diversity Qualitative assessments of species diversity (species richness, numbers, and equity) were made on the basis of the cover and frequency data collected in the irrigated pasture, swale/drainage, and sagebrush vegetation types. Quantitative methods, including diversity indices and rank correlation tests, were not applied because of the inherent shortcomings associated with these techniques (Chambers 1983). Similarity coefficients were not applied because of the inherent dissimilarity of the plant communities found on the study site, and the fact that a reference area approach for determining revegetation success at the New Horizon 2 area is not being proposed.

5.0 Vegetation Baseline Sampling Results and Discussion - 1987

In 2008, NRCS designated certain soils as prime farmland soils. This led to the redesignation of Irrigated Pasture Hayland (IH) on the Morgan property being redesignated as Cropland - Irrigated Hay (IC). Additionally, as of Permit Revision 06, an area of 25.06 acres on the Burbridge property north of Pond 007 have been redesignated as Cropland - Small Grain (ICSG) based on determinations made by DRMS.

5.1 Vegetation Distribution and Floristics - 1987 Vegetation types were determined on the basis of plant composition and land use. Six vegetation types were recognized in the New Horizon 2 baseline vegetation studies: sagebrush, swale/drainage, irrigated pasture, irrigated hayland, irrigated cropland, and miscellaneous types. Farmsteads, facilities (corrals, stockyards, haystacks), orchards, ponds, roads and other (abandoned cropland, abandoned

buildings, etc.), were included in the miscellaneous category. The distribution of each type is shown on Map 2.04.10. The total acreage of each type in the study area and proposed permit area is shown in Table 2.04.10-4.

The plant list resulting from the floristic surveys conducted with the study area is presented in Attachment 2.04.10-5 (formerly Peabody Appendix 10-1). The list is arranged in alphabetical order by plant morphological class. Species are identified according to scientific name, common name, occurrence in the various vegetation types, and native or introduced. The list includes 208 species of vascular plants. The morphological classes represented by the most species in Attachment 2.04.10-5 (formerly Peabody 10-1) include perennial forbs (65), perennial graminoids (46) and annual forbs (37).

The search of the Colorado Natural Areas Inventory data base indicated that no data are available for the locality in which the study area occurs. However, both the Colorado Department of Natural Resources and the U.S. Fish and Wildlife Service indicated that Lupinus crassus (Payson lupine) could possible occur on the site. Payson lupine is a U.S. Fish and Wildlife Service category 2 species. Category 2 species are candidates for listing as endangered or threatened for which additional data are needed before listing can proceed. Thorough searches of the study area, including searches of likely microhabitats, failed to produce any specimens of Payson lupine. The searches also failed to produce any other plant species of special concern. The results indicate that it is extremely unlikely that any such species occur in the study, or proposed permit area.

A number of Colorado designated noxious weeds were found during the 1987 vegetation surveys. The presence of these noxious and restricted weeds is not unexpected due to the intensive agricultural activities and large amount of disturbed and abandoned areas within the study area. There were four prohibited noxious weeds encountered during the studies. They are:

Field bindweed	(Convolvulus arvensis)
Jointed goat grass	(Aegilops cylindrica)
Canada thistle	(Cirsium arvense)
Hairy whitetop	(Cardaria pubescens)

In addition five restricted noxious weeds were also found. They are:

Curly dock	(Rumex crispus)
Blue lettuce	(Lactuca pulchella)
Buckhorn plantain	(Plantago lanceolata)
Poverty sumpweed	(Ira axillaris)
Quackgrass	(Agropyron repens)

The above noxious weeds were determined from Appendix B to OMLR's draft "Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining".

Table 2.04.10-4
Total Acreages of the Various Vegetation Types
Found In the New Horizon 2
Study Area and mine Disturbance Area - 1987

	1987 - Study Area		Disturbance Area	
Vegatation Type	**Acreage**	**% of Total**	**Acreage**	**% of Total**
Sagebrush	43.9	7.1	25.52	7.68
Swale/Drainage	83.4	13.5	54.74	16.48
Irrigated Pasture	194.1	31.4	68.76	20.71
Irrigated Pasture Hayland	97.5	15.8	130.86	39.41
Irrigated Cropland	102.4	16.6	25.02	7.53
Farmsteads/Disturbed/Roads	79.8	12.9	23.67	7.13
Ponds	5.6	0.9	2.62	0.79
Orchards	11.1	1.8	0.89	0.27
Total	617.8	100.0	332.08	100.0

5.2 Irrigated Pasture Type - 1987 (IP) The irrigated pasture represents lands intermediate between the remnant sagebrush types (generally a former pinyon-juniper woodland site) and the more intensively managed irrigated hayland type. Depending on the objectives of the land manager or the level of management applied, lands that may be adapted to hayland production or lands that are only slightly more adapted than the sagebrush type for pasture production are included.

As anticipated, total vegetative cover was high at 72 percent (Table 2.04.10-5) with litter averaging 23 percent, for an average total ground cover of 95 percent. Bare ground averaged only five percent. Total vegetation and litter combined would most likely have approached 100 percent if not for the affects of grazing pressure in the pastures. Consistent with the management and use of these lands, perennial graminoids dominated at 43 percent of the vegetative cover while perennial forbs accounted for nearly all of the remaining vegetative cover (29 percent). The only other morphological class represented was annual forbs at a low 0.3 percent cover. Of all species encountered in cover sampling, Kentucky bluegrass (Poa pratensis) had the highest cover and second highest frequency at 21 percent and 87 percent, respectively. Buckhorn plantain followed closely with the second highest cover (14 percent) and highest frequency (93 percent). Other important species were orchardgrass (Dactylis glomerata) at 9 percent cover (67 percent frequency), white Dutch clover (Trifolium repens) at 9 percent cover (80 percent frequency), timothy (Phleum pratense) at 3 percent cover (60 percent frequency), dandelion (Taraxacum officinale) at 3 percent cover (53 percent frequency) and red clover (Trifolium pratense) at 2 percent cover (47 percent frequency). A summary of the individual transect data is presented in Attachment 2.04.10-6 (formerly Peabody 10-2 (Table 2-1)). Total annual production for the type was estimated at 2,822.6 pounds/acre (Table 2.04.10-6). Indicative of the highly variable nature of the type, production estimates from the sample plots ranged from 230 pounds/acre to 8,994 pounds/acre. This large variation was due to the amount and timing of irrigation water application, the amount of supplemental water received which was incidental to the regularly applied amount, and the intensity and duration of grazing prior to the placement of range cages. As an example, sample 2 was dominated by Kentucky bluegrass and buckhorn plantain (Attachment 2.04.10-6, formerly Peabody Appendix 10-2, Table 2-2)). Both require supplemental water to be present and survive in the arid Nucla area and both are dominant in irrigated pasture in the study area. However, a history of heavy continuous grazing and poor irrigation water application by

Table 2.04-10-5

Mean Cover (Percent) and Frequency Values For The

Irrigated Pasture Vegetation Type,

New Horizon 2 Study Area, 1987

Species	Mean Percent Cover (N=15)	Frequency
Perennial Graminoids		
Agropyron repens	2.8	33
Agrostis alba	1.2	20
Bromopsis inermis ssp. inermis	.1	7
Dactylis glomerata	9.2	67
Eleocharis macrostachya	0.1	7
Festuca arundinacea	3.1	33
Festuca pratensis	0.5	20
Hordeum jubatum	1.1	13
Muhlenbergia asperifolia	1.3	20
Phleum pratense	3.1	60
Poa pratensis	20.5	87
Total Perennial Graminoids	**43.0**	**---**
Perennial Forbs		
Aslepias subverticulata	0.1	7
Convolvulus arvensis	0.4	20
Medicago sativa	0.3	13
Platago lanceolata	14.0	93
Plantago major	0.1	7
Taraxacum officinale	2.7	53
Trifolium pratense	2.0	47
Trifolium repens	8.5	80
Perennial forb (unk)	0.4	13
Total Perennial Forbs	**28.5**	**---**
Annual Forbs		
Erodium cicutarium	0.2	7
Medicago lupulina	0.1	7
Total Annual Forbs	**0.3**	**---**
Total Vegetation (First Hit)	**71.8** **s = 11.9**	
Litchen and Moss	0.3	
Litter	22.7	
Bare ground	5.1	
Rock	0.3	

Minimum sample size required (n_{min}) = 8 (based on total vegetation)

Table 2.04.10-6

Mean Herbaceous Production (g/0.25m^2) For The Irrigate Pasture Vegetation Type, New Horizon 2 Study Area, 1987

Mean Herbaceous Production	g/0.25m^2	g/m^2	lbs/ac	kg/ha
	79.2	316.8	2822.6	3168.0

Note: s = 54.2 (g/0.25m^2)

N = 51

Minimum sample size required (n_{min}) = 127

the operator during the 1987 growing season resulted in a very low productive state. Likewise, sample 20 occurred in an area that receives some benefit from a ground water seep, as well as the normal application of irrigation water. A summary of the individual production plot data is presented in Attachment 2.04.10-6 (formerly Peabody Appendix 10-2 (Table 2-2)).

The irrigated pasture type contains incidental woody species at varying densities based on the level of management or maintenance applied to these pastures. All woody plants are invaders in the irrigated pasture type. Some operators periodically grub out the woody plants, while others allow their continued existence. The actual densities observed in the field were low, a fact borne out by the lack of woody plants present in the cover samples (Attachment 2.04.10-6, formerly Peabody Appendix 10-2, Table 2-1). Therefore, an estimate of woody plant density was made by directly counting individuals from stereo color aerial photographs (1" = 500' scale) flown in June 1987. Field checks for verification were made in mid-September 1987. As shown in Table 2.04.10-7, the stem density averaged a low six per acre, comprised of the five species listed. The total estimate for the type was 947 trees.

Table 2.04.10-7

Mean Woody Plant Density (Stems/Acre) For Irrigated Pasture Vegetation Type, New Horizon 2 Study Area, 1987[1]

Species	Stems/acre
Eleagnus angustifolia	0.5
Juglans nigra[2]	0.1
Acer negundo	0.1
Rosa nutkana	5.3
Ulmus pumila	0.1
Total	6.1

[1] Tree densities reflect absolute counts of species occurring in the irrigated pasture type using color aerial photography (stereo pairs, 1 = 500' scale). The total tree estimate for the irrigated pasture type was 947 trees. Populus sargentii and Populus angustifolia occasionally occurred along irrigated pasture borders containing ditches but were not included in the densities.

[2] Three Juglans nigra occurred in an irrigated pasture on the west side of the study area.

A total of 66 species were found to occur in the type (Attachment 2.04.10-6, formerly Peabody 10-1), with 21 of those species encountered in the cover sampling. Only 12 of these species had relative cover values of 1 percent or greater. Of these 12 species, 8 were graminoids and four were forbs. Though this represents a low level of diversity for native plant communities, irrigated pastures that are in good condition and well managed should have a composition of only a few species (Stewart 1973).

The general stocking rate for the irrigated pasture is approximately 1.2 AUM's/acre at a 70 percent utilization rate. Since the production on these pastures can be sustained by irrigation, this stocking rate should apply during the majority of the growing season. Ideally, the forage should achieve a 4-5 inch height in the spring and between pasture recovery periods before grazing with allowance for a 4-5 inch stubble height of vegetation remaining at the end of the

growing season (SCS 1985). Observations during 1987 indicate that the trend is to graze early, continuously during the growing season, and late for a number of the operators.

Many factors contribute to the composition, utility and appearance of the irrigated pasture type. Soils vary from moderately deep loams to shallow loams and with a number of rock outcrops (see Section 2.04.9, Soils Resource Information). The deeper soils could be placed in hay production, however the various operators' management objectives dictate a use of these lands for irrigated pasture. At the other extreme, are the areas of shallow soils. These lands normally occur as the remnant sagebrush type or as disturbed areas associated with farmsteads or facilities. In these cases, the operator has chosen to apply irrigation water on seeded pasture species even though the site potential is low. In some cases, the sites are so shallow, that tillage and seeding are not feasible and continued application of irrigation water has allowed for volunteering of species normally found in the irrigated pasture type. These shallow, sites have a lower production potential than the deeper sites, but it is much higher than if left in the dry remnant sagebrush state. Within the irrigated pasture type are small localized areas that receive only limited amounts of supplemental irrigation water because of the natural topography or land form. These areas are too small to stratify out from the type. Land leveling or shaping to overcome these problems has not been done to any great extent within the study area. Ground water seeps and boggy areas from irrigation runoff and irrigation recharged ground water systems contribute to areas of higher production or occur as small inclusions of the swale/drainage vegetation type.

The overall composition and species diversity of the site is indicative of the generally poor condition of the irrigated pasture type. Both Kentucky bluegrass and buckhorn plantain dominate the composition of the stand and have frequencies of occurrence of about 90 percent (see Table 2.04.10-5). The considerable presence of quackgrass, field bindweed, and dandelion is also indicative of the deteriorated pasture condition. Most of the operators contacted indicated that a standard pasture mix originally was used to establish most of the pastures. Smooth brome (Bromopsis inermis ssp. inermis), orchardgrass, timothy, white Dutch clover, and red clover occurred in the pasture type and are normally included in standard irrigated pasture mixes.

The most productive, nutritious and easily managed irrigated pasture systems contain only one or two grasses and a legume (Heath et al. 1985 and Stewart 1973). Proper stocking, grazing rotations allowing for regrowth periods, grazing periods timed to irrigation frequencies, controlling animal pressure during the off-grazing season, and fertilizer applications based on soil tests are all components of good pasture management. Varying levels of these management inputs are used by the local operators, but observations indicate none are at the required levels. Woody densities within the irrigated pastures are incidental and a result of the generally low level of management applied. Nootka rose (Rosa nutkana) is a common invader shrub of irrigated pastures in the Nucla area, with Russian olive (Eleagnus angustifolia) occurring at lesser levels (see Attachment 2.04.10-8 Figure 4-2, formerly Peabody Appendix 10-4).

5.3 Irrigated Pasture - Hayland Type (IPH) The irrigated pasture hayland type occurs on a variety of soils and landforms within the study area. Generally, the lands with less steep slopes and deeper soils are selected, however, steeper slopes and shallow soils may be encountered in any of these hay fields. With the exception of one operator, fields are periodically renovated in order to maximize hay production and quality. Renovation is oriented towards removing undesirable weedy or poor producing species, eliminating sod bound conditions, and reestablishing an alfalfa (Medicago satira) dominated stand with one or two associated grasses. The single operator who does not periodically renovate, manages his hay field as a grass dominated stand with a clover sub-component. This field is similar in composition to the better levels of irrigated pasture. Representative photographs of the irrigated hayland type may be found in Attachment 2.04.10-8, formerly Peabody Appendix 10-4 (Figures 4-3 and 4-4 - Figure 4-3 and the foreground of Figure 4-4 show grass and clover dominated hayland; Figure 4-4 (middleground) shows an alfalfa dominated stand.)

Harvest period, number of harvests during the growing season, fertilization programs, and management of the stands after harvest were all different for the various operators. Number of harvests varied from one to three per growing season, with the first cut harvest date varying from June 17 to September 16. This variability reflects different management levels and objectives.

Seasonal hay production values for the five operators cutting hay in the study area are presented in Table 2.04.10-8. The average production for all first cut hay was 1,932 pounds/acre and ranged from a low of 1,168 pounds/acre to a high of 3,021 pounds/acre for the five operators. Cutting dates ranged from June 17, 1987 to as late as September 16, 1987. Only two operators (Garvey and Goforth) took a second cutting of hay, with production values of 1,050 pounds/acre and 3,325 pounds/acre, respectively, for the two operators. Second cut harvest dates were approximately one month apart at August 12, 1987 and September 16, 1987. Only one operator (Goforth) took a third cutting of hay. The hay fields were harvested on October 28, 1987 and averaged 1,557 pounds/acre production (Table 2.04.10-8). All values represent adjusted dried weights.

Composition of the irrigated pasture hayland type is highly variable depending on the individual operator. Garvey and Goforth have both recently renovated all or parts of their hay fields. These renovated fields are dominated by alfalfa and contain various companion grasses such as orchardgrass and smooth brome. Staats' fields also have a fair alfalfa composition. Morgan's hay fields contain some alfalfa, but the alfalfa is being replaced by the pasture clovers. In addition, desirable pasture grasses are being supplanted by Kentucky bluegrass, quackgrass, meadow fescue (Festuca pratensis), tall fescue (Festuca arundinacea), buckhorn plantain, and dandelion. Burbridge does not manage for alfalfa in his hay fields and does not regularly renovate these fields because of shallow soils and rock ledges. Consequently these haylands are dominated by a variety of desirable and increaser grasses, red and white Dutch clover, weedy forb species and occasional alfalfa plants.

Upon review of Table 2.04.10-8 it becomes apparent that there are large variations in production for the various operators. All operators indicated in interviews that they felt that the annual production potential of their haylands is 3+ tons/acre. Only one operator, Goforth, achieved this with an approximate total production after three cuttings of 4 tons/acre. As stated earlier, when all operator's production were equated to first cutting values, production varied from a low of 1,168 pounds/acre to over 3,000 pounds/acre. Out of five operators harvesting hay, two took a second cutting, and only one took a third cutting. To achieve 3 tons/acre production, the average production for each of three cuttings would need to be 2,000 pounds/acre. The lower overall production for most operators and the wide differences reflect the variation in management of the operators and site variability. Differing management

objectives and the level of applied management in any given year (or season) result in short term variation in production, while site characteristics, including topography and depth of soils, determine long term production. Soils range from moderately deep to shallow loams, but most operators acknowledged the presence of rock ridges with shallow soil cover in several of the fields. Topography affects the level of efficiency for irrigation water application when using flood type irrigation. UnduIating topography with irregular contours results in areas receiving too little water and other areas receiving an excess, resulting in boggy conditions or the drowning out of more desirable species such as alfalfa.

The varying management objectives and level of inputs are best illustrated by summarizing information provided by the various operators during 1987. Goforth makes a conscientious effort towards irrigation water management, fertilizes with approximately 150 pounds/acre of 18-46-0 fertilizer and occasionally with 150 pounds/acre of potash, and does not overutilize the aftermath in the hay fields during the non-growing season. The fields are also periodically renovated.

Periodic renovation and application of phosphorous fertilizer on a regular basis maintains a good alfalfa component in a stand which significantly increases yields and forage quality (Heath et al. 1985 and Schumaker et al. 1967). By comparison, the Morgan hay fields (San Miguel property) were grazed heavily by livestock during the late winter and into the early spring after growth had started. Morgan does not fertilize regularly and alfalfa composition in the stand is low, while poorer producing species, such as Kentucky bluegrass and buckhorn plantain, have a high composition. Several rock ridges with shallow soils also occur in these fields, further reducing potential production. Burbridge, who does not fertilize his hay fields, has little alfalfa in the stand, and significant areas of shallow soils with rock ridges. Combined, these result in a potentially low level of productivity in his hay fields. However the hay production from this field is adequate to meet Burbridge's needs and thus the incentive for more intensified management is not there. It should be pointed out that Burbridge's cut hay was rained on twice and turned twice before baling which will reduce both the yield and quality of hay. Staats' hay production values, though higher than most first cuttings, still does not reflect the potential production. Because of land leveling on Staats' fields, cut areas (exposing subsoil materials with lower production potential) have lower overall yields, though irrigation water management is benefited. Staats' fields (in the proposed permit area) north of Calamity

Draw are not intensively managed because of more productive and easier managed fields south of Calamity Draw, and an already adequate hay base provided from these latter fields. Staats' fields which were included in this study are not fertilized on a regular basis, irrigation water application is not consistent during the growing season, and the fields are grazed during the non-growing season. This reflects management during the last several years. A portion of Garvey's hay fields were renovated in 1986 and herbicides were applied to control persistent perennial weeds such as Canada thistle and quackgrass. The fields have not been fertilized for several years, some areas of shallow or boggy soils occur in part of the fields, alfalfa composition in some of the older fields is low, and the hay fields were grazed during the winter and into the early growing season. These factors all combined to reduce production below the potential in Garvey's fields.

In summarizing the type, varying site characteristics, individual management objectives, II applied management, and number of cuttings, result in wide ranges in production for the type. Based on the 1987 field data collection, only one operator at this time manages for sustained production during the growing season that approaches the potential of the site.

Table 2.04.10-8

Seasonal Hay Production (LBS/AC) For The Various Operators Utilizing The Irrigated Pasture Hayland Type, New Horizon 2 Study Area 1987

OPERATOR NAME	DATE	PRODUCTION (LBS/AC)	DATA SUMMARY (FROM PEABODY PERMIT DOCUMENT)
First Cut:			
Garvey	6/26/87	1333	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-3)
Goforth	6/27/87	3021	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-4)
Morgan	6/25/87	1168	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-5)
Burbridge	8/13/87	1758	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-6)
Staats	9/16/87	2380	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-7)
Average		1932	
Second Cut:			
Garvey	9/16/87	1050	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-8)
Goforth	8/12/87	3235	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-9)
Average		2188	
Third Cut:			
Goforth	10/28/87	1557	Attachment 2.04.10-6, formerly Peabody Appendix 10-2 Table 2-10)

5.4 Swale/Drainage Type (IPSW) Flood irrigation of lands on and adjacent to the study area has created water regimes in certain locations that favor the establishment of hydrophytic and phreatophytic vegetation (see Attachment 2.04.10.-5,Figure 4-5, formerly Peabody Appendix 10-4). These situations occur where: 1) small natural drainages or swales (with gentle slopes) collect tailwater drainage from the surrounding irrigated fields; 2) shallow ground water, augmented by irrigation, daylights along exposed bedding planes or fractured rock to form seeps and boggy areas; 3) shallow water conditions exist along the borders of ponds and depressions in channels; and 4) stable conditions occur on portions and banks of the two streams draining the study and surrounding area (Calamity Draw and Tuttle Draw). Because of the variation in site specific water regimes within the type, three major components may be delineated. Dense thickets of coyote willow (Salix exigua) occur on shallow, slightly elevated sites along the drainages where better-drained conditions exist (see midground of Figure 4-3, Attachment 2.04.10-8, formerly Peabody 10-4) or in areas surrounding seeps with similar conditions. Less well-drained areas, or areas where standing or slow-flowing water occurs during much of the growing season, support vegetation that is dominated by phreatophytic and hydrophytic graminoids (carices, rushes, and sedges). The least well-drained areas, or areas where standing water persists, are dominated exclusively by thick stands of cattail (Typha latifolia also a perennial graminoid).

The graminoid-dominated component characterizes the swale/drainage type because of its greater areal extent (approximately 80 percent of the type) than the other two components and its potential grazing utility. The remaining two components generally occur in the eastern half of the study area and almost exclusively in the proposed permit area. Small isolated occurrences of cattails and willows may occur in the western half of the study area. Where significant areas of cattails and willows occur, they form islands or stringers within the graminoid component. Where all three components occur together, they form a relatively complex mosaic (see Attachment 2.04.10-8, Figure 4-5, formerly Peabody Appendix 10-4).

Vegetation cover, frequency and herbaceous production samples were concentrated in the graminoid component of the swale/drainage type primarily because of measurability and the fact that this component comprises the majority of the type. The willow component has a closed canopy and measurement of the production of shrubs is not required by OMLR regulations. However, density data in the willow thickets was collected. No data was collected

from the cattail component. Both the willow and cattail components function primarily as wildlife habitat (see Section 2.04.11, Fish and Wildlife Resources Information). The cover and frequency sampling results for the graminoid component are summarized in Table 2.04.10-9. The individual plot data, from which the summary is derived, may be found in Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-11).

Total vegetation cover was estimated at 60.6 percent (Table 2.04.10-9). The cover of litter and bare ground was 88.5 and 0.7 percent, respectively. Hydrophytic graminoids comprised most of the vegetal cover (54.4 percent total cover) followed by perennial forbs (2.6 percent total cover), annual forbs (1.9 percent total cover) and shrubs (1.9 percent total cover). The dominant graminoids in terms of both cover and frequency of occurrence included western sedge (Carex occidentalis), threesquare (Scirpus pungens) and common spikerush (Eleocharis macrostachya). Other graminoids, such as redtop (Agrostis alba), Parry rush (Juncus parryi) and alkali muhly (Muhlenbergia asperifolia) were frequently encountered in the sample, but contributed relatively 1ess to total vegetation cover. A total of 14 species of perennial graminoids were encountered in the sample. Cattail did not occur in any of the randomly located sample plots, although this species occurs in the graminoid component as scattered monotypic stands that range in size from approximately 0.1 to 2 acres.

Eight species of perennial forbs occurred in the cover and frequency sample (Table 2.04.10-9). The dominant perennial forb was white prairie aster (Aster adscendens). This species comprised nearly one-half of the perennial forb cover and occurred in 50 percent of the cover plots. Only three species of annual forbs and one shrub species were represented in the samples.

The mean herbaceous production in the graminoid component of the swale/drainage type is presented in Table 2.04.10-10. Individual plot data used to derive the summary may be found in Attachment 2.04.10-6, formerly Peabody 10-2 (Table 2-12). Table 2.04.10-10 expresses production on a dry weight basis by morphological class as grams per 0.25m^2 (plot size), pounds per acre and percent composition by weight. The results indicate that perennial graminoids dominated the type component in terms of biomass (97.8 percent of the total above-ground plant biomass). Perennial and annual forbs contributed only minor amounts to

total herbaceous production. Total production exceeded that of any vegetation type sampled (3,500.2 pounds/acre).

The willow component of the swale/drainage type occurs on shallow, slightly elevated sites that are better-drained than areas supporting vegetation that can tolerate standing or flowing water, and completely saturated conditions. No attempt was made to sample cover in the willow component because of the extremely high shrub densities encountered. Qualitative evaluation indicated that the canopy and ground cover, including litter, in the willow thickets was equal to or greater than 100 percent. In more open areas where the willows were less dense, quackgrass, alkali muhly and common spikerush were prevalent.

Table 2.04.10-9
Mean Cover (Percent) and Frequency Values For The Swale/Drainage Vegetation Type, New Horizon 2 Mine Study Area, 1987

Species	Percent Cover	Frequency
Graminoids		
Agropyron repens	1.9	10
Agrostis alba	1.8	33
Carex nebrascensis	2.0	7
Carex occidentalis	18.3	43
Eleocharis macrostachya	11.1	53
Hordeum brachyantherum	<0.1	3
Hordeum jubatum	0.2	10
Juncus parryi	2.7	47
Muhlenbergia asperifolia	3.2	27
Phleum pratense	0.7	7
Poa pratensis	0.8	23
Pucinellia lemmoni	0.2	23
Scirpus	11.3	67
Sitanion Longifolium	0.1	10
Total Graminoids	**54.4**	**---**
Perennial Forms		
Aster adscendens	1.2	50
Centaurea maculosa	<0.1	3
Epilobium ciliatum	0.1	3
Plantago lanceolata	0.4	3
Ranunculus cymbalaria	0.1	3
Rumex crispus	0.3	3
Taraxacum officinale	0.3	3
Trifolium repens	0.2	7

Total Perennial Forbs	**2.6**	**---**
Annual Forbs		
Chenopodium Berlandieri	<0.1	3
Lactuca spp.	1.7	20
Melilotus officinalis	0.2	3
Total Annual Forbs	**1.9**	**--**
Shrubs		
Salix exigua	1.9	20
Total Vegetation	**60.6**	
Litter	88.5	
Bare Ground	0.7	

Note: Slight difference in values from Attachment 2.04.10-6, formerly Peabody Appendix 10-2, Table 2-11 are due to rounding.

Table 2.04.10-10

Mean Haerbaceous Production and Percent Composition (By Dry Weight) For The Morphological Classes Encountered in Samples of The Swale/Drainage Vegetation Type, New Horizon 2 Study Area, 1987

(n=50)

		Production		Percent
Morphological Class	grams/plot (0.25m^2)	lbs/acre	kg/ha	Composition
Perennial Graminoids	95.9	3,421.7	3,837.0	97.8
Perennial Forbs	1.7	60.7	68.0	1.7
Annual Forbs	0.5	17.8	20.0	0.5
Total 98.1	3,500.2	3,925.0	100.0	

The results of shrub density samples conducted in the willow thickets are summarized in Attachment 2.04.10-6, formerly Peabody Appendix 10-2 (Table 2-12). The mean density of coyote willow, the only shrub species represented, was 10.0 individuals per meter square. This translates to 40,540 individuals per acre. Each individual willow had from one to eight stems associated with the crown, so the total stem density would be substantially greater. These density figures do not represent an average density for the swale/drainage type as a whole, but only in the thickets. In addition to the willows, approximately 14 cottonwoods (Populus angustifolia and Populus sargentii) and 48 Russian olives occurred in the swale/drainage vegetation type (from direct counts). The above two species occur in the drier phase or fringes of the swale/drainage, or adjacent to ponds.

A total of 48 species were found in the swale/drainage type (Attachment 2.04.10-5, formerly Peabody Appendix 10-1), indicating a higher 1eve1 of diversity than is apparent with only casual observation. Graminoids dominated as expected, with a total of 14 species (see Table 2.04.10-9) with 10 having relative cover values of one percent or greater. Annual and perennial forbs totaled only slightly less at 11, yet only one perennial and one annual forb had relative cover greater than 1 percent. One shrub, coyote wi1low, was encountered in cover sampling and it had a relative cover of three percent. The swale/drainage type was less diverse than the irrigated pasture type and ranked as the third most diverse type.

The third component of the swale/drainage vegetation type, the cattail component, was not sampled since it is only a small community. This component is nearly 100 percent cattail, excepting some associated pond weeds shown in the species list (Attachment 2.04.10-5, formerly Peabody 10-1). Standing water occurs in the component essentially all year long. The cattail component is further described in Attachment 2.04.10-10, formerly Peabody Addendum 11-1.

The extent and distribution of the swale/drainage type is wholly dependent upon the irrigation associated with the surrounding agricultural areas excepting any contribution from storm flows or snowmelt runoff. The type would not persist if the irrigation system was not present, as evidenced by the similar landscape in Third Park to the north where irrigation is not present. Undoubtedly, the ephemeral drainages could not support this vegetation without the supplemental water. The contribution of supplemental water from irrigation tailwater is greatest during the mid-April to October irrigation season, while ground water recharged from irrigation may contribute to seeps and bogs over a greater period.

Each component of the swale/drainage type exhibits very high 10-32 levels of productivity and cover, although the vegetation supports little utility other than wildlife habitat. The surrounding pasture and hayland vegetation offers considerably better quality forage for livestock. The boggy conditions of the swales and the occurrence of large volumes of coarse and rank standing dead vegetation probably precludes utilization of the type as well. Local landowners expressed somewhat derisive remarks about the type, indicating that it constitutes lands that could be put to greater use if the saturated conditions could be controlled. Reference to Section 2.04.11, Fish and Wildlife Resources Information, can be made for further information on the type.

5.5 Sagebrush Type (SG, SG-1, SG-2) The sagebrush vegetation type represents remnants of native rangeland have not been converted to the more characteristic intensive agricultural land uses in the area. These areas have not been converted because of topographic restrictions affecting irrigation water application and the occurrence of rock outcrops or shallow soils. The type usually occurs as small inclusions within the irrigated pasture type, within or adjacent to the swale/drainage type, or is associated with facilities and disturbed areas. The sagebrush type was delineated based on the dominance of sagebrush within these areas.

Some areas mapped as such may occasionaly receive supplemental moisture during the growing season from adjacent agricultural activities, however, a sagebrush overstory with an associated understory of introduced and native species are present along with the irrigated pasture invader species Kentucky bluegrass. Attachment 2.04.10-8, Figure 4-6 (formerly Peabody Appendix 10-4) shows one of the larger blocks of this type in the study area. A grazing exclosure is also shown in the photograph.

Total vegetation cover (first hit) for the type averaged 37 percent, with bare ground at 29 percent, litter at 30.2 percent, and rock at 3.7 percent (Table 2.04.10-11). Lichen and moss accounted for only 0.1 percent of the mean cover. The shrub component dominated with 13.5 percent cover followed closely by the annual grass component at 12.7 percent cover. Perennial grasses and forbs at 7.3 and 2.6 percent cover, respectively, followed in importance. Consistent with the type designation, Basin big sagebrush (Artemisia tridentata ssp. tridentata) had the highest perennial species cover at 11.5 percent (97 percent frequency), while the ubiquitous invader of sagebrush rangelands, cheatgrass (Bromus tectorum) had the highest cover for any species at 12.7 percent (90 percent frequency). Kentucky bluegrass had the third highest cover at 2.7 percent (43 percent frequency) and blue grama (Bouteloua gracilis), crested wheatgrass (Agropyron desertorum), hairy goldenaster (Heterotheca villosa), broom snakeweed (Gutierrezia sarothrae) all had approximately 1 percent cover. The remaining species generally contributed less than one half percent cover to the mean total vegetative cover.

Herbaceous production totaled 20.0 g/m2 or 178.4 pounds/acre (Table 2.04.10-12). The perennial grass component contributed the highest value at 13.6 g/m (242.4 pounds/acre) followed by perennial forbs at 5.4 g/m^2 (96.2 pounds/acre). While the contribution of annual grasses 2 and forbs was low (0.2 and 0.8 g/m^2, respectively), their actual contribution to annual production is most likely higher. In order to sample the perennial species at the peak of their production, many of the earlier maturing annual species were senescent or were already gone from the stand.

Table 2.04.10-11
Mean Cover Values For The Sagebrush Vegetation Type
New Horizon 2 Study Area, 1987

Species	Mean Percent Cover (n=30)	Frequency
Annual Grasses		
Bromus japonicus	<0.1	3
Bromus tecterum	12.7	90
Total Annual Grasses	**12.7**	**--**
Perennial Grasses		
Agropyron desertorum	1.0	20
Agropyron intermedium	0.1	3
Agropyron smithii	0.1	7
Bouteloua gracilis	1.3	30
Bromopsis inermis ssp. inermis	0.3	10
Dactylis glomerata	0.1	3
Hilaria jamesii	0.4	17
Munienopergia asperifolia	0.5	13
Poa pratensis	2.7	43
Sitanion longifolium	0.2	13
Sporobolus cryptandrus	0.2	7
Stipa neomexicana	0.3	7
Total Perennial Grasses	**7.3**	**--**
Annual/Biennial Forbs		
Descurainia richardsonii ssp. incisa	<0.1	3
Melilotus officinalis	0.1	7
Solanum rostratum	<0.1	3
Tragapogon dubius	<0.1	3
Total Annual/Biennal Forbs	**0.2**	**--**
Perennial Forbs		
Cirsium Arvense	<0.1	3
Centaurea maculosa	0.2	10
Convolvulus arvensisa	0.2	7
Eriogonum lonchophyllum	0.1	3
Heterotheca villosa	1.1	20
Hymenoxys villosa	0.1	3
Leptodactyion pungens	<0.1	3
Leuceiene ericoides	<0.1	3
Plantago lanceolata	0.1	10
Sonaeralcea coccinea	0.6	37
Taraxacum officinale	<0.1	3
Total Perennial Forbs	**2.6**	**--**
Shrubs		
Artemisia tridentata ssp. tridentata	11.5	97
Atriplex canescens	0.1	7
Chrysothamnus nauseosus	0.6	17
Gutierrezia sarothrae	1.2	37
Total Shrubs	**13.5**	**--**

Table 2.04.10-12
Mean Herbaceous Production (g/m^2) Values
For The Sagebrush Vegetation Type
New Horizon 2 Study Area, 1987

(n=30)

Morphological Class	Mean Production (g/m^2)			
Perennial Grasses	13.6			
Perennial Forbs	5.4			
Annual Grasses	0.2			
Annual Forbs	0.8	s	lbs/ac	kg/ha
Total	20.0	10.1	178.4	201.1

Minimum Sample size required (n_{min})= 274 (based on total production)

Table 2.04.10-13
Mean Woody Plant Density (Stems/$50m^2$)
For The Sagebrush Vegetation Type
New Horizon 2 Study Area, (1987)
(n=30)

Species	Mean Density(stems/$50m^2$)			
Artemisia tridentata ssp. tridentata	38.9			
Atriplex canescens	1.0			
Chrysothamnus nauseosus	4.6			
Ephedra viridis	0.4			
Juniperus osteosperma	0.1			
Populus sargentii	0.1			
Tamarix sp.	0.1			
Ulmus pumila	0.4			
Gutierrezia sarothrae	27.7	s	#/ac	#/ha
Total	**73.4**	**55.5**	**5,945**	**14,706**

Minimum sample size required (n_{min})= 155 (based on total density)

Woody plant density was measured as opposed to shrub density because of the occurrence of subshrubs and the occasional presence of tree species in the type. Succulents were not included in the density calculations. Mean density for the type was 73.4 stems/50m2 or 5,945 stems/acre (Table 2.04.10-13). Basin big sagebrush dominated with an average density of 38.9 stems/50m2 (3,150.9 stems/acre) and a frequency of 100 percent. Indicative of the deteriated state of this type, broom snakeweed had a measured density of 27.7 stems/50m2 (2,243.7 stems/acre). Other species of importance were rubber rabbitbrush (Chrysothamnus nauseosus) and fourwing saltbush (Atriplex canescens) at 4.6 stems/50m2 (372.6 stems/acre) and 1.0 stems/50m2 (81.0 stems/acre), respectively.

A total of 86 species occurred in the sagebrush type (Attachment 2.04.10-5, formerly Peabody 10-1), making it the most diverse type studied. Of this total, 36 species occurred in the cover samples, however, only 11 species had relative cover values of 1 percent or greater. Grasses (including annuals) comprised 14 of the species (see Table 2.04.10-11), while annual/biennial/perennial forbs totaled 15. Four shrubs occurred in the cover samples, as did one succulent and two trees.

The sagebrush vegetation type as identified within the study area occurs on soils of the Travessilla-Pinon channery sandy loam complex (see Attachment 2.04.10-9, formerly Peabody Attachment 9-5). Within the complex are small inclusions of Progresso loam soils. No range sites are identified for the Travessilla or Pinon soils because the native vegetation on these soils is typically a pinyon-juniper dominated woodland (see Attachment 2.04.10-7, formerly Peabody Appendix 10-3). As evidenced by the cover data, and verified by field observations, the pinyon-juniper woodland overstory has been essentially removed. The removal of this overstory plus the level of disturbance associated with livestock use and man's impact has completely altered the composition of the site. In evaluating the Guide for Determining Forage Condition attached to the Pinyon-Juniper Woodland Site Description, it is apparent that the sites would only warrant a poor forage condition rating. Note that no woodland site index information has been provided in the Site Description. The Progresso soils within the complex are not mapped out because of the small size of these inclusions, and hence the locations of the applicable semidesert loam, range site cannot be identified. The stocking rate for the sagebrush type is estimated at a low 0.09 AUM's/ac or 12 acres/AUM assuming use of all grasses and the more palatable forbs.

As stated earlier, the sagebrush type represents a remnant native community that has been severely altered because of intensive agricultural land use and associated support activities. Though these sites normally have a pinyon-juniper tree overstory previously discussed), these have most likely been removed for fencing materials, firewood, land clearing, and from the impacts of high concentrations of grazing animals. Most of the type occurs as inclusions in irrigated pastures or adjacent to the highly productive swale type. The pastures are usually heavily stocked at least during part of the year, resulting in a high level of animal pressure from grazing and trampling. The sites are also periodically used as equipment parking, storage, or boneyard areas and winter livestock feeding areas. The shallow soils, rock outcrops, and low natural precipitation, further reduce the potential productivity of the site, while increasing the potential for further deterioration and decreasing the opportunity for any recovery. The majority of species encountered during cover sampling (see Table 2.04.10-11) were increaser or invader species. Consistent with the composition of severely deteriorated native plant communities in the Great Basin and Colorado Plateau regions, cheatgrass, Basin big sagebrush and broom snakeweed accounted for nearly 70 percent of the vegetative cover, mile the latter two shrubs accounted for 88 percent of the woody plant densities. Because of less severe animal impacts, the far eastern portion of the study area containing the sagebrush type appeared to be in slightly better condition. The occurrence of grass, forb and tree species adapted to more mesic conditions (see Table 2.04.10-11) is a result of occasional supplemental moisture received as tailwater from adjacent irrigated areas. This is not a dependable supply of water and appears to be more a function of timing and the level of irrigation water management applied to these adjacent lands. The presence of a heavy sagebrush overstory and the senescent condition of the mesic species at the time of sampling indicates only a sparse supplemental water availability.

The type is not an important component when considering the local land use and management objectives. Conversion to a higher or better use would be done if not for the militating site conditions and associated costs.

5.6 Irrigated Cropland (IC) Within the study area, irrigated cropland (Attachment 2.04.10-8, Figures 4-7 and 4-8, formerly Peabody Appendix 10-4) generally occurs on flat to gently sloping landforms that have moderately deep to deep soils (see Section 2.04.9, Soils Resource Information). The most extensive area of irrigated cropland occurs in the western portion of the study area, with the balance occurring in the central portion of the study area.

Considering landform and soils, the cropland areas in the western portion of the study area are more conducive to cropping activities. The cropland areas in the central portion of the study area contain areas with shallow soils or boggy ground which restrict yields and equipment operation. The central portion of the study area containing cropland is also in the western portion of the permit area. Soils in the cropland portion of the permit area are dominated by the Progresso complex (Unit 30C). Soils within this complex are generally shallow, have a poor capability class, and require a high level of management inputs. The low potential of the cropland in the permit area is partially reflected in their present poor condition. Cropping may be periodically carried out in other portions of the study area outside of the above areas, however this lasts only one to two years as a rotation during renovation of hayland or pastureland.

Crops normally grown in the Nucla area include corn for silage and small grains such as oats, winter wheat, and barley. During the 1987 growing season, only one field (located in the southwest corner of the study area) was planted to a crop. This field was planted to winter wheat for grain, but was pastured in the fall/winter after the grain had established and stooled out. Prior to the grain maturing during the summer of 1987, a short term management decision by the operator resulted in the entire stand being grazed by sheep instead of harvested for grain. All other fields within the study area were left fallow during the 1987 cropping season. The two fields in the western portion of the study area that were not in winter wheat during 1987, were tilled late in the year during 1987 as a fallow/weed clean-up operation (see Attachment 2.04.10-8 Figures 4-7 and 4-8, (formerly Peabody 10-4). Note: photos taken prior to fallow operation). The two cropland areas in the central portion of the study area (western edge of the permit area) were not tilled after harvest the previous year and were allowed to volunteer barley and a host of annual and perennial weedy species. All cropland areas contain many weedy species. These species are noted in Attachment 2.04.10-5, formerly Peabody Appendix 10-1 "Species List".

Since no cropland was placed in production or harvested during 1987, no specific yield data is available for the study area. An estimate of the capability of the major soils in the study area may be gained by review of the soils map unit descriptions and soils interpretation sheets (SCS Form 5's) contained in Section 2.04.9, Soils Resource Information. For the Barx series (map unit 70B), the more extensive of the two series cropped, the following values might be

achieved under a high level of management (irrigated): corn silage - 22 tons/acre, alfalfa hay - 5.5 tons/acre, grass hay - 4.5 tons/acre, oats - 80 bushels/acre, and barley - 110 bushels/acre. For the Progresso series (map unit 30C), the following values may be attainable under a high level of management (irrigated): corn silage 18 tons/acre, alfalfa - 5 tons/acre, grass hay - 4 tons/acre, oats 70 bushels/acre, and barley - 110 bushels/acre. Interviews during 1987 with the operator managing the cropland areas indicated that the actual yields are much lower. It was estimated by this operator that corn silage production was 13 tons/acre, barley was 60 bushels/acre, with wheat as high as 30 bushels/acre; all values indicating a lower level of management applied or reflecting poorer site conditions than what the soil survey indicates, or a .combination of both. Observations of the condition of these cropland fields during 1987 support the contention that these lands receive only an average level of management at best.

The cropland area in the western portion of the permit area has been managed by Mr. Frank Morgan for approximately 20 years (personal communication, August 1988). During that period he has not managed for any yield level, has not maintained any formal data on yields, and has many times used the lands for grazing and haying of annual grains. The lands have also been fallowed periodically. Recent examples are the fallow condition of the fields in 1987 and the last minute decision to graze seeded annual grains by sheep in 1988. The Agricultural Stabilization and Conservation Service (ASCS) office in Montrose, Colorado has no historic farm based yield numbers for the cropland fields within the permit area (personal communication, ASCS office August 1988).

Mr. Morgan estimated that the cropland within the western portion of the permit area yields about 60 bushels per acre for barley and 20-25 bushels per acre for winter wheat. Mr. Zene Weimer, one of the better farm operators in the Nucla area, was contacted because of his familiarity with the lands in question (personal communication, August 1988). Surprisingly, his independent estimate of yields for the cropland area in the permit area was similar to Morgan's. An estimate of potential grass hay production may be gained from evaluation of the hay fields just north of the cropland areas within the permit area (discussed earlier in this section). These hay fields have similar site conditions and soils as the cropland areas, the majority being mostly Progresso complex soils (Map Unit 30C). The hayland north of the cropland in the permit area is dominated by grasses. Table 2-5 in Attachment 2.04.10-6, formerly Peabody Appendix 10-2 shows estimated hay yields for these fields to be 1,168

pounds/acre. Since soils and site conditions are identical for the two areas, this yield must be the potential for the areas identified as cropland within the permit area. Therefore baseline information may be assumed to be similar for the two areas.

5.7 Farmsteads, Orchards, Facilities, and Other Types The remainder of the study area includes farmsteads, orchards, support facilities, roads, ponds, irrigation ditches, and disturbed areas. Because of the intensity of activity in the area, the number of operators within the study area, and the length of time that these activities have been ongoing in the area, a significant amount of the study area is included within this category (approximately 16 percent of the study area and 8 percent of the permit area).

There are eleven active farmsteads or homesites within the study area and three inactive or abandoned farmsteads. Five farmsteads or homesites occur within the permit area. The size of these range from over three acres down to less than one acre and include buildings, yards, corrals and other support facilities (see Attachment 2.04.10-8, Figure 4-4, background, and Figure 4-8, right background, formerly Peabody Appendix 10-4). In the western half, and a portion of the southeast corner of the study area, the farmsteads and homesites have been established on the better soils and more gentle topography of the study area. The remainder are located on poorer soils that tend to be rocky and shallow, though the topography tends to be relatively gentle. Vegetation in these areas consists of a variety of annual and perennial exotic species, as well as remnant examples of the native plant populations. Dominating the vegetation are large native and exotic shade trees, as well as ornamental and exotic shrubs. Attachment 2.04.10-5, formerly Peabody Appendix 10-1 "Species List" lists the more prominent species found in these areas. A detailed survey for herbaceous species was not conducted in the farmstead areas because of the numerous garden, ornamental, and other exotic species normally found in these areas.

Six abandoned orchards occur within the study (see Attachment 2.04.10-8, midground of Figure 4-9, formerly Peabody Appendix 10-4). The dominant species in these orchards is apple (Malus sylvestris), with peach (Prunus persica) and apricot (Prunus armeniaca) also occasionally present. The orchards were established coincidentally with establishment of the Nucla community and mining activities in the Telluride Mining District where much of the harvested fruit was sold to the mining community. By the 1940's the market was essentially

defunct, and the orchards began to be abandoned (Johnson, personal communication, May, 1987). Interviews with operators who live or operate within the study area indicate that incidental use is made of these orchards by the local population today, but for all practical purposes, they are no longer harvested. In many cases, they are fenced, but livestock are periodically allowed access to use the forage in the understory, as evidenced by the "high lined" lower tree canopy and grazed condition of the understory plants. Several operators complained of livestock health or digestive problems because of ingestion of apples. The understory is predominated by herbaceous species such as quackgrass, plantains, and dandelion.

Facilities were identified as farm support areas if they were located away from farmsteads. These included animal handling pens, stockyards, silage pits, and equipment storage or boneyard areas. These areas are dominated by weedy annual and perennial species.

Disturbed areas, a rather self descriptive term, included areas with heavy animal concentrations, mechanical disturbance due to equipment operation, trash dumps, and waste ground associated with various agricultural and support activities (Attachment 2.04.10-8, Figure 4-10, formerly Peabody Appendix 10-4.)

Ponds and irrigation ditches of various capacities are scattered throughout the study area. A large lateral ditch (West Lateral) runs through the western half of the study area, however several smaller lateral ditches deliver water to the various irrigated fields, pastures and hay fields in the study and permit area (see Section 2.04.7, Hydrology Description). The vegetation in or near these ditches is dominated by many of the species that occur in the swale and irrigation pasture vegetation types. Cottonwoods, boxelder (Acer negundo), and willows are prominent components of the vegetation associated with these ditches, while the dense cover of graminoid and occasional forb species protect the banks of the ditches from erosion. A total of 17 ponds, 4 of which are in poor repair, occur within the study area. Five of these ponds occur within the permit area. Ponds are maintained to catch irrigation and storm runoff water for livestock use. All operators stated that the ponds were not associated with any irrigation systems or water storage for that purpose. The vegetation around these ponds is similar to that found in the swale type and along the irrigation ditches. Pond weeds found

during 1987 include water milloil (Myriophyllum sibiricum), pondweed (Potomogeton graminifolius) and horned pondweed (Zannichellia palustria).

A review of information contained in the SCS Montrose County Soil Survey and Attachment 2.04.10-9, formerly Peabody Attachment 9-5 was made to determine the appropriate range sites applicable to the study area in order to determine the potential plant communities in the farmstead, facilities, orchards, etc. type. One range site, Semidesert Loam, and one woodland site, Pinyon-Juniper Woodland, apply to the New Horizon 2 study area for these areas., The reviewer is directed to Map 2.04.9-1 "Soil Types and Topsoil Salvage Depth" and Attachment 2.04.10-9, formerly Peabody Attachment 9-5 contained in Tab 9 as support for this discussion. Both the Pinyon-Juniper Site Description and the Semidesert Loam Range Site are included in Attachment 2.04.10-7, (formerly Peabody Appendix 10-3).

6.0 Vegetation Baseline Sampling Results and Discussion - 1999

In 2008, NRCS designated certain soils as prime farmland soils. This led to the redesignation of Irrigated Pasture Hayland (IH) on the Morgan property being redesignated as Cropland - Irrigated Hay (IC). Additionally, as of Permit Revision 06, an area of 25.06 acres on the Burbridge property north of Pond 007 have been redesignated as Cropland - Small Grain (ICSG) based on determinations made by DRMS.

6.1 Vegetation Distribution and Floristics - 1999 Vegetation types were determined on the basis of plant composition and land use. Six vegetation types were recognized in the New Horizon 2 baseline vegetation studies permit expansion area: sagebrush-1 (SG-1), sagebrush-2 (SG-2) swale/drainage (IPSW), irrigated pasture (IP), irrigated pasture hayland (IPH), and miscellaneous types. Farmsteads, facilities (corrals, stockyards, haystacks), orchards, ponds, roads and other (abandoned cropland, hayland and pastures, abandoned buildings, etc.), were included in the miscellaneous category. The distribution of each type is shown on Map 2.04.10. The total acreage of each type in the study area and proposed permit area is shown in Table 2.04.10-14.

The plant list resulting from the floristic surveys conducted with the study area was presented in Attachment 2.04.10-5 formerly Peabody Appendix 10-1. It is reproduced and annotated as

necessary as Appendix 2.04.10-1 for the amended area. The list is arranged in alphabetical order and contains approximately 150 species of plants. Species are identified according to scientific name and common. Scientific names in parenthesis are the most current accepted nomenclature using ITIS Integrated Taxanomic Information System : http://www.itis.usda.gov/plantproj/itis/itis_query.html

The search of the Colorado Natural Areas Inventory data base indicated that no data are available for the locality in which the study area occurs with the nearest site being established in 1997 on the San Miguel river near Tabeguache Creek. The CDMG list, NRCS PLANTS database, and the USFWS database were used as the most current lists of threatened and endangered plants.

The search of the Colorado Natural Areas Inventory data base indicated that no data are available for the locality in which the study area occurs. However, both the Colorado Department of Natural Resources and the U.S. Fish and Wildlife Service indicated that Lupinus crassus (Payson lupine)

Table 2.04.10-14

Total Acreage of The Various vegetation Types

Found in The New Horizon 2 Permit Expansion

Study Area and Mine Disturbance Area - 1999

	1999 -Study Area		Disturbance Area	
Vegatation Type	**Acreage**	**% of Total**	**Acreage**	**% of Total**
Sagebrush -1 (SG-1)	72.0	15.3	59.3	16.8
Sagebrush -2 (SG-2)	15.0	3.2	7.7	2.0
Swale/Drainage (IPSW)	21.5	4.6	21.5	4.7
Irrigated Pasture (IP)	244.0	51.7	208.5	55.5
Irrigated Pasture Hayland (IPH)	76.0	16.1	58.7	15.8
Flood Plain (FP)	9.0	1.9		
Deciduous Trees (DT)	7.0	1.5		
Pinon-Juniper (PJ)	1.0	0.1		
Farms/Roads/Disturbed (F, R, & D)	24.5	5.2	18.0	4.8
Ponds (P)	2.0	0.4	2.1	0.4
TOTAL	**472.0**	**100.0**	**375.8**	**100.0**

could possibly occur on the site. Payson lupine is a U.S. Fish and Wildlife Service category 2 species. Category 2 species are candidates for listing as endangered or threatened for which additional data are needed before listing can proceed. Thorough searches of the study area, including searches of likely microhabitats, failed to produce any specimens of Lupinus crassus.

A number of Colorado designated noxious weeds were found during the 1987 and again in the 1999 vegetation surveys. The presence of these noxious and restricted weeds is not unexpected due to the intensive agricultural activities and large amount of disturbed areas within the study area. There were six prohibited noxious weeds encountered during the 1999 studies. They are:

Field bindweed	(Convolvulus arvensis)
Jointed goat grass	(Aegilops cylindrica)
Canada thistle	(Cirsium arvense)
Hairy whitetop	(Cardaria pubescens)
Russian Knapweed	(Centaurea repens)
Musk Thistle	(Cardus nutans)

In addition four restricted noxious weeds were also found. They are:

Curly dock	(Rumex crispus)
Blue lettuce	(Lactuca pulchella)
Buckhorn plantain	(Plantago lanceolata)
Quackgrass	(Agropyron repens)

The above noxious weeds were determined from Appendix B to CDMG draft "Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining".

6.2 Irrigated Pasture Type (IP) The irrigated pasture has been cleared of native vegetation and planted to grasses and forbs by the various farms in the study area. All the irrigated pastures are irrigated by means of flooding the fields from ditches. Irrigated pastures vary from abandoned to highly productive. Some pastures, where irrigation water stands for prolonged periods, is dominated with sedges and rush. Other abandoned pastures are dominated with annual, bi-annual and noxious weeds. After consulting, in the field, with Harry Ranney, Colorado Dept. of Minerals and Geology, it was determined that two pastures with reasonable levels of management would be selected for sampling. One pasture was owned by Morgan and the other by Benson. Both had been irrigated in the 1999 season and both had little to no grazing influence. Results of cover, production and woody stem density were based on these two pastures.

Perennial grasses dominated the irrigated pasture type with vegetative cover of 44.5 percent, while perennial forbs accounted for nearly all of the remaining vegetative cover (33.3 percent).

Total annual production for the type was estimated at 4,153 pounds/acre. Woody stem density was zero in this type. A total of 64 species were found to occur in the type, with 21 of those species encountered in the cover sampling. Only 15 of these species had relative cover values of 1 percent or greater. Of these 15 species, 8 were graminoids and 7 were forbs.

Irrigated pasture occurs on soil map units 98A, 98C, 98D, 98E and 98F and 98G. Soil ranges from deep to shallow. Moderately deep to deep irrigated pastures have a potential to become irrigated haylands. Some operators have chosen to let hayland areas degrade over time so that the current use is irrigated pasture. Pastures on shallow soil have a lower production value and are irrigated solely due to the fact that they are down slope from an irrigation ditch.

The 1987 conclusions are restated here as they have the same application and results as those found in 1999. The general stocking rate for the irrigated pasture is approximately 1.2 AUM's/acre at a 70 percent utilization rate. Since the production on these pastures can be sustained by irrigation, this stocking rate should apply during the majority of the growing season. Ideally, the forage should achieve a 4-5 inch height in the spring and between pasture recovery periods before grazing with allowance for a 4-5 inch stubble height of vegetation remaining at the end of the growing season (SCS 1985). Observations during 1999 indicate that the trend is to graze early, continuously during the growing season, and late for a number of the operators.

Many factors contribute to the composition, utility and appearance of the irrigated pasture type. Soils vary from deep sandy loams to shallow sandy loams with a few rock outcrops (see Section 2.04.9, Soils Resource Information). The moderately deep to deep soils could be placed in hay production, however the various operators' management objectives dictate a use of these lands for irrigated pasture. At the other extreme, are the areas of shallow soils. These lands normally occur as the remnant sagebrush type or as disturbed areas associated with farmsteads or facilities. In these cases, the operator has chosen to apply irrigation water on seeded pasture species even though the site potential is low. In some cases, the sites are so shallow, that tillage and seeding are not feasible and continued application of irrigation water has allowed for volunteering of species normally found in the irrigated pasture type. These shallow, sites have a lower production potential than the deeper sites, but it is much higher than if left in the dry remnant sagebrush state. Within the irrigated pasture type are

small localized areas that receive only limited amounts of supplemental irrigation water because of the natural topography or landform. These areas are too small to stratify out from the type. Land leveling or shaping to overcome these problems has not been done to any great extent within the study area. Ground water seeps and boggy areas from irrigation runoff and irrigation recharged ground water systems contribute to areas of higher production or occur as the swale/drainage vegetation type.

The overall composition and species diversity of the site is indicative of the generally poor condition of the irrigated pasture type. Both Kentucky bluegrass and buckhorn plantain dominate the composition of the stand and have frequencies of occurrence of greater than 85 percent (see Table 2.04.10-15). The considerable presence of quackgrass, field bindweed, and dandelion is also indicative of the deteriorated pasture condition. Most of the operators contacted indicated that a standard pasture mix originally was used to establish most of the pastures. Smooth brome (Bromopsis inermis ssp. inermis), orchardgrass, timothy, white Dutch clover, and red clover occurred in the pasture type and are normally included in standard irrigated pasture mixes.

Nootka rose (Rosa nutkana) is a common invader shrub of irrigated pastures in the Nucla area, with Russian olive (Eleagnus angustifolia) and elm (Juglans nigra) occurring at lesser levels where pastures have been abandoned.

6.3 Irrigated Pasture - Hayland Type (IPH) *Since this description was originally written by IRI in 1999, the Morgan fields east of the fenceline in the southwest portion of the 1999 study area have been re-classified as Irrigated Cropland (IC). Therefore, the discussion and tables for this vegetation type include some Morgan fields which are Irrigated Cropland (IC) and some Irrigated Pasture - Hayland fields (IPH). The original narrative, which has not been changed, is included below.*

The irrigated pasture hayland type occurs on property owned by Morgan, Johnson and Benson. Only Johnson and Morgan are currently mowing and baling hay from their fields. Benson property northwest of BB and 2700 Road has been used only for irrigated pasture in the last several years. These fields generally occur on soil map units 98D and 98E (NHM 2.04.9 - Soil Resource Information) within the study area. Slopes range 1 to 4 percent with a small area of slopes up to 6 percent. Results are summarized in Table 2.04.10-18.

The Morgan property has three hayland fields. The first field of 21 acres is currently raising alfalfa. The field has been furrowed and is supplied water via gated irrigation pipe. Morgan manages the alfalfa by plowing it up every 5 to 7 years. The field is disked and furrowed. The field is then fertilized and planted to alfalfa. Each year the furrows are cleaned to insure the proper flow of irrigation water. The field yielded 2,034 bales on first cutting in 1999 with and average bale weight of 88 lb/bale. The production for this field was 178,992 pounds (2,034 bales X 88 lb/bale) or 8,523 lb/acre. The second Morgan hayland field of 28 acres is a mixture of grasses and forbs with approximately 10 to 15 percent alfalfa. The field was not irrigated this year and white tail prairie dogs have invaded about 1/8 of the field. Further cattle grazed the field from late winter into the growing season. Morgan was going to renovate the field but did not have the time this year. Morgan mowed and baled the field to reduce annual weeds and allow for future operations. The field yielded 394 bales on first cutting with an average bale weight of 81 lb/bale. The production for this field was 31,914 pounds (394 bales X 81 lb/bale) or 1,140 lb/acre. The third field on the Morgan property was a small sub-irrigated 1 acre parcel of grass and forbs. The field yielded 21 bales on first cutting with an average bale weight of 87 lb/bale. The production for this field was 1,827 pounds (21 bales X 87 lb/bale) or 1,827 lb/acre.

Johnson's property has two hayland fields that yielded similar production. The first pasture on the western portion of the property is 20 acres in size. The field is primarily grasses and forbs

with approximately 5 percent alfalfa. The field yielded 1,024 bales on the first cutting with an average bale weight of 86 lb/bale. The production for this field was 88,064 pounds (1024 bales X 86 lb/bale) or 4,403 lb/acre (2.2 tons/acre). The second field on the southern part of the property is 11 acres in size. The field is primarily grass and forbs with about 5 percent alfalfa. The field yielded 517 bales on the first cutting with an average bale weight of 84 lb/bale. The production for this field was 43,428 pounds (517 bales X 84 lb/bale) or 3,948 lb/acre (1.97 tons/acre).

Morgan plans a second cutting of alfalfa. Neither Johnson or Morgan plan a second cutting of their grass hay and neither property owner remember previous years yields as both indicated "they get what they get and stack it up".

Composition of the irrigated pasture hayland type is highly variable from field to field. Fields generally in good condition are dominated by orchard grass, smooth brome, alfalfa and clover. Areas that have poor drainage are dominated with rushes and sedges. Areas in less than good conditions are dominated with Kentucky bluegrass and various weeds.

Morgan, Johnson and Benson all thought that they could achieve an annual production potential of 3+ tons/acre in two cuttings as was asserted by operators in 1987 and reiterated in 1999. Since Johnson was the only person to both irrigate and harvest, his two first cutting fields of 2.2 and 1.97 tons/acre are within the 1987 assumptions of area operators. These figures are higher than those shown in table 2.04.10-8 which indicates an average 1932 lbs/acre (.97 tons/acre) in 1987. Variation in yield in 1999 was directly related to the degree of management and climatic variability. The Alfafa field which was intensively managed produced the highest yields (8523 lbs/acre) while the least managed field that had been invaded by prarie dogs had the lowest yield (1140 lbs/acre).

A dominant factor contributing to production values in 1999 is the climatic trend for 1998-1999. 1999 is thus far proving to be an excellent year for herbage production. The 1998-1999 winter was warm and mild (table 2.04.10-2) and the precipitation for spring and summer has been high (Table 2.04.10-1). Precipitation is running 177 percent of normal for the San Miguel Basin (NRCS, NOAA). This trend has had the effect of elevating production levels.

Table 2.04.10-15

Mean Cover (Percent) and Frequency Values For

The Irrigated Pasture (IP) Vegetation Type,

New Horizon 2 Permit Expansion Study Area, 1999

Species	Mean Percent Cover (n=30)		Frequency
Perennial Graminoids			
Agropyron repens	3.3		33
Agrostis alba	1.3		13
Bromopsis inermis ssp. inermis	2.0		07
Dactylis glomerata	10.3		57
Festuca arundinacea	1.7		17
Festuca pratensis	0.3		03
Muhlenbergia asperifolia	2.3		23
Phleum pratense	4.3		37
Poa pratensis	19.0		90
Total Perennial Graminoids	**44.5**		---
Perennial Forbs			
Cichorium intybus	1.0		10
Convolvulus arvensis	0.3		03
Medicago sativa	2.7		13
Plantago lanceolata	5.7		57
Taraxacum officinale	3.3		33
Trifolium pratense	7.7		53
Trifolium repens	12.7		63
Total Perennial Forbs	**33.5**		**---**
Total Vegetation (First Hit)	**78.0**	**s = 9.97**	
Lichen and Moss	0.3		03
Litter	18.7		83
Bare ground	3.0		17
Total Other	**22.0**		**--**

Minimum sample size required (n_{min}) = 30 (based on total vegetation)

Table 2.04.10-16

Mean Herbaceous Production (g/0.25m^2) For The Irrigated Pasture Vegetaton Type, New Horizon 2 Permit Expansion Study Area, 1999

MEAN HERBACEOUS PRODUCTION	g/0.25m^2	g/m^2	lbs/ac	kg/ha
Perennial Graminoids	98.9	395.6	3,533	832
Perennial Forbs	17.4	69.6	621	1,552
Total Annual Production	116.3	465.2	4,153	10,384

Note: s = 21.56

N = 50

Minimum sample size required (n_{min}) = 50

Table 2.04.10-17

Mean Woody Plant Density (Stems/Acre) For Irrigated Pasture Vegetation Type, New Horizon 2 Permit Expansion Study Area, 1999

Species	Stems/Acre
None	0.0
Total	0.0

No woody stems occurred in the irrigated pastures

Table 2.04.10-18

First Cut Hay Production (lbs/ac) For The Various Operators Utilizing

The Irrigated Pasture Hayland Type (IPH),

New Horizon 2 Permit Expansion Study Area 1999

OPERATOR NAME	DATE	ACRES	BALES	BALE WEIGHT	PRODUCTION (Lbs/ac)
Morgan					
Field 1	6/25/99	21	2034	88	8523[1]
Field 2	7/01/99	28	394	81	1140[2]
Field 3	7/02/99	1	21	87	1827[3]
Johnson					
Field 1	7/03/99	20	1024	86	4403
Field 2	7/04/99	11	517	84	3948
Clipped Plots(IP)	7/20/99				4,135[4]

1 - Alfalfa

2 - Not irrigated in 1999

3 - Sub-irrigated in 1999

4 - Average of 1/4M2 plots N=50 Nmin=50 s=21.56

Note: Morgan fields 1, 2, and 3 have now been changed to Irrigated Cropland (IC) since the 98E soils have been reclassified in this area as prime farmland soils. These field designations, however, are only used to describe pre-mine data.

6.4 Swale/Drainge Type (IPSW) Flood irrigation of lands on and adjacent to the study area has created water regimes in certain locations that favor the establishment of hydrophytic and phreatophytic vegetation. These situations occur where: 1) small natural drainages or swales (with gentle slopes) collect tailwater drainage from the surrounding irrigated fields; 2) shallow ground water, augmented by irrigation, daylights along exposed bedding planes or fractured rock to form seeps and boggy areas; 3) shallow water conditions exist along the borders of ponds and depressions in channels. Because of the variation in site specific water regimes within the type, three components occur within the type: 1) Dense thickets of coyote willow (Salix exigua) which occur primarily adjacent to the west lateral CC Ditch. 2) Less well-drained areas, or areas where standing or slow-flowing water occurs during much of the growing season, support vegetation that is dominated by phreatophytic and hydrophytic graminoids (carices, rushes, and sedges). 3) The least well-drained areas, or areas where standing water persists, are dominated exclusively by thick stands of cattail (Typha latifolia also a perennial graminoid).

The graminoid-dominated component characterizes the swale/drainage type because of its greater areal extent (approximately 95 percent of the type) than the other two components and its potential grazing utility. Cattail occurs primarily adjacent to stock ponds and in tailwater drainage ditches. Willow is primarily restricted to the banks of the west lateral CC Ditch. Where significant areas of cattails and willows occur, they form islands or stringers within the graminoid component.

Vegetation cover, frequency and herbaceous production samples were concentrated in the graminoid component of the swale/drainage type primarily because of measurability and the fact that this component comprises the majority of the type. The willow component has a closed canopy and measurement of the production of shrubs is not required by CDMG regulations. However, density data in the willow thickets was collected. No data was collected from the cattail component. Both the willow and cattail components function primarily as wildlife habitat (see Section 2.04.11, Fish and Wildlife Resources Information). The cover and frequency sampling results for the graminoid component are summarized in Table 2.04.10-19.

Total vegetation cover was estimated at 59.0 percent (Table 2.04.10-19). The cover of litter and bare ground was 40.8 and 0.2 percent, respectively. Hydrophytic graminoids comprised

most of the vegetal cover (41.9 percent total cover) followed by perennial forbs (3.5 percent total cover), annual forbs (0.2 percent total cover).

The mean herbaceous production in the graminoid component of the swale/drainage type is presented in Table 2.04.10-20. Table 2.04.10-20 expresses production on a dry weight basis by morphological class as grams per 0.25m^2 (plot size), pounds per acre and percent composition by weight. The results indicate that perennial graminoids dominated the type component in terms of biomass (90.6 percent of the total above-ground plant biomass). Perennial and annual forbs contributed 9.4 percent to total herbaceous production. Total production exceeded that of any vegetation type sampled (8,236 pounds/acre).

Table 2.04.10-19

Mean Cover (percent) And Frequency Values For The Swale/Dainage (IPSW)

Vegetation Type, New Horizon 2 Mine Permit Expansion Study Area, 1999

SPECIES	PERCENT COVER(N=30)	FREQUENCY
Graminoids		
Agropyron repens	1.1	10
Carex nebrascensis	1.6	17
Carex occidentalis	7.5	43
Carex sp.	12.7	53
Dactylis glomerata	1.3	10
Digitaria sanquinalis	0.2	3
Disticalis spicata	0.4	3
Echinochola crus-galli	0.2	3
Echinochola colona	0.1	3
Eleocharis macrostachya	7.1	53
Hordeum jubatum	0.1	10
Juncus sp.	4.1	50
Muhlenbergia asperifolia	2.8	27
Poa pratensis	1.1	10
Pucinellia lemmoni	0.2	17
Scirpus spp.	8.1	47
Sitanion Longifolium	0.1	10
Trifolium sp.	1.3	17
Unknown	5.6	57
Total Graminoids	**55.3**	**---**
Perennial Forbs		
Allium sp.	0.1	3
Asclepias sp.	0.1	3
Aster adscendens	1.2	50
Convolulusus arvensis	0.2	7
Epilobium ciliatum	0.1	3
Medicago sativa	0.8	3
Plantago lanceolata	0.4	3
Rumex crispus	0.3	3
Taraxacum officinale	0.3	3
Total Perennial Forbs	**3.5**	**---**
Annual Forbs		
Melilotus officinalis	0.2	3
Total Annual Forbs	**0.2**	**---**
Total Vegetation(first hit)	59.0 s = 9.6	
Litter	40.8	
Bare Ground	0.2	

Minimum sample size required (n_{min}) = 28 (based on total vegetation)

Table 2.04.10-20

Mean Herbaceous Production and Percent Composition (by dry weight)

For The Morphological Classes Encountered in Samples Of The

Swale/Drainage (IPSW) Vegetation Type

New Horizon 2 Permit Expansion Study Area, 1999

(n=50)

MORPHOLOGICAL CLASS	GRAMS/PLOT ($0.25M^2$)	PROD. LBS/ACRE	KG/HA	PERCENT COMPOSITION
Perennial Graminoids	208.9	7,461	8,357	90.6
Perennial Forbs	21.7	775	868	9.4
Total	**230.6**	**8,236**	**9,225**	**100.0**

The willow component of the swale/drainage type occurs on shallow, slightly elevated sites that are better-drained than areas supporting vegetation that can tolerate standing or flowing water, and completely saturated conditions. No attempt was made to sample cover in the willow component because of the extremely high shrub densities encountered. Qualitative evaluation indicated that the canopy and ground cover, including litter, in the willow thickets was equal to or greater than 100 percent. In more open areas where the willows were less dense, quackgrass, alkali muhly and common spikerush were prevalent.

The mean density of coyote willow, the only shrub species represented, was 78 stems per meter square. This translates to 312,000 stems per acre. The density of actual willows is expected to be much lower. It was impossible to tell which stem went with which individual and since willow is a clonal body individuals are in determinant. These density figures do not represent an average density for the swale/drainage type as a whole, but only in the thickets.

A total of thirty species were found in the swale/drainage type. Graminoids dominated, with a total of twenty species (see Table 2.04.10-19) with ten having relative cover values of one

percent or greater. Annual and perennial forbs totaled ten, only one perennial forb had relative cover greater than 1 percent.

The third component of the swale/drainage vegetation type, the cattail component, was not sampled since it is only a small community. This component is nearly 100 percent cattail. Standing water occurs in the component essentially all year long. The cattail component is further described in Attachment 2.04.10-10, formerly Peabody Addendum 11-1 and is the same as was found in 1999.

The extent and distribution of the swale/drainage type is wholly dependent upon the irrigation associated with the surrounding agricultural areas excepting any contribution from storm flows or snowmelt runoff. Undoubtedly, the ephemeral drainages could not support this vegetation without the supplemental water. The contribution of supplemental water from irrigation tailwater is greatest during the mid-April to October irrigation season, while ground water recharged from irrigation may contribute to seeps and bogs over a greater period.

Each component of the swale/drainage type exhibits very high levels of productivity and cover, although the vegetation supports little utility other than wildlife habitat. The surrounding pasture and hayland vegetation offers considerably better quality forage for livestock. The boggy conditions of the swales and the occurrence of large volumes of coarse and rank standing dead vegetation probably precludes utilization of the type as well. Local landowners expressed somewhat derisive remarks about the type, indicating that it constitutes lands that could be put to greater use if the saturated conditions could be controlled. Reference to Section 2.04.11, Fish and Wildlife Resources Information, can be made for further information on the type.

6.5 Sagebrush - 1 Type (SG-1) The sagebrush-1 vegetation type represents remnants of native rangeland that has not been converted to the more characteristic intensive agricultural land uses in the area. This type occurs on mesa tops and shoulder slopes. The potential natural vegetation probably included pinon and juniper along with sagebrush and understory rangeland plants. Most of the pinon juniper has been removed and the remaining sagebrush has been treated by mowing or herbicide spraying on gentler slopes. Additionally, cattle, particularly during winter months, have heavily impacted this type, removing much of the

desirable understory range plants. These areas have not been converted to more intensive land uses because of topographic restrictions affecting irrigation water application and the occurrence of rock outcrops or shallow soils. The type usually occurs where slopes are too steep to irrigate or where it was not feasible to bring water to the land via a ditch. This sagebrush type was delineated based on the dominance of sagebrush within these areas. The sage brush ranged in height from 1 ft. to 2.5 ft. with a average sagebrush height of 1.5 ft. Sagebrush vigor and form are restricted by shallow depth to bedrock in this type. Slopes ranged 3 to 60 percent. Some areas mapped as such may occasionally receive supplemental moisture during the growing season from adjacent agricultural activities, however, a sagebrush overstory with an associated understory of introduced and native species are present along with the irrigated pasture invader species Kentucky bluegrass.

Total vegetation cover (first hit) for the type averaged 34 percent, with bare ground at 36 percent, litter at 22 percent, and bedrock or rock fragments at 8 percent (Table 2.04.10-21). Lichen and moss accounted for 1.1 percent of the mean cover. The shrub component dominated with 16.2 percent cover followed closely by the perennial grass component at 7.5 percent cover. Annual grasses at 6.8 percent cover, followed in importance. Consistent with the type designation, sagebrush (Artemisia tridentata) had the highest perennial species cover at 13.9 percent (47 percent frequency), while the ubiquitous invader of sagebrush rangelands, cheatgrass (Anisantha tectorum) had a cover of 6.8 percent (41 percent frequency). Blue grama had the third highest cover at 5.1 percent (29 percent frequency). The remaining species generally contributed less than one percent cover to the mean total vegetative cover.

Total herbaceous production (including shrubs) totaled 43.01 g/m2 or 386.02 pounds/acre (Table 2.04.10-22). Herbaceous production without the shrub component totaled 8.07g/m2 or 74.1 pounds/acre. The perennial shrub component contributed the highest value at 34.94 g/m (311.4 pounds/acre) followed by perennial grasses at 5.47 g/m^2 (48.8 pounds/acre). While the contribution of annual grasses and forbs was (2.6 and 0.2 g/m^2, respectively), their actual contribution to annual production is most likely higher. In order to sample the perennial species at the peak of their production, many of the earlier maturing annual species were senescent or were already gone from the stand.

Woody plant density measurements in 1999 differed from 1987 as suffruticose species were not measured consistent with Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining. Succulents were also not included in the density calculations. Mean density for the type was 17.23 stems/50m2 or 2,517 stems/acre (Table 2.04.10-23). Sagebrush dominated with an average density of 17 stems/50m2 or (2,483 stems/acre). Other species included Utah juniper with 0.03 stems/50m2 or (12 stems/acre) and four-wing saltbrush with 0.2 stems/50m2 or (29 stems/acre).

Nineteen species occurred in the cover samples, however, only 4 species had relative cover values of 1 percent or greater. Grasses (including annuals) comprised 6 of the species (see Table 2.04.10-21), while annual/biennial/perennial forbs totaled 4. Five shrubs occurred in the cover samples, as did two succulent and two trees.

Table 2.04.10-21

Mean Cover (percent) and Frequency Values For The Sagebrush - 1 Vegetation Type, New Horizon 2 Permit Expansion Study Area, 1999

SPECIES	MEAN PERCENT COVER (N=55)	FREQUENCY
Annual Grasses		
Anisantha tectorum	6.8	41
Total Annual Grasses	**6.8**	**--**
Perennial Grasses		
Bouteloua gracilis	5.1	29
Oryzopsis hymenoides	0.2	01
Hilaria jamesii	0.1	01
Sitanion longifolium	0.4	02
Stipa neomexicana	1.7	13
Total Perennial Grasses	7.5	--
Perennial Forbs		
Cirsium Arvense	<0.1	01
Leptodactylon pungens	0.3	02
Sonaeralcea coccinea	0.1	01
Taraxacum officinale	<0.1	01
Total Perennial Forbs	2.6	--
Shrubs		
Artemisia tridentata	13.9	47
Atriplex canescens	0.9	01
Ephedra viridis	0.1	01
Eurotia lanata	0.2	01
Gutierrezia sarothrae	1.1	10
Total Shrubs	**16.2**	**–**
Trees		
Juniperus osteosperma	0.4	02
Pinus edulis	<0.1	01
Total Trees	0.4	--
Succulents		
Opuntia polyacantha	0.3	03
Yucca glauca	0.1	01
Total succulents	**0.3**	**–**
Micsellaneous		
Litter	23.0	
Bare	37.1	
Rock Fragments	6.1	
Total Miscellaneous	66.2	

Minimum Sample size required (n_{min})= 44 (based on total living cover)

Table 2.04.10-22
Mean Herbaceous Production (g/m^2) Values
For The Sagebrush - 1 (SG-1) Vegetation Type
New Horizon 2 Permit Expansion Study Area, 1999
(n=50)

MORPHOLOGICAL CLASS	MEAN PRODUCTION (G/M^2)		
Perennial Shrubs	34.94		
Perennial Grasses	5.47		
Perennial Forbs	0.00		
Annual Grasses	2.60		
Annual Forbs	0.00		
Total	**43.01**	lbs/ac	kg/ha
(with P. Shrubs)	20.78	386.02	432.35
(Without P. Shrubs)	4.76	74.08	82.97

Minimum Sample size required (n_{min}) = 47 (based on total production)
Minimum Sample size required (n_{min}) = 2 (based on total production less P. shrubs)

Table 2.04.10-23
Mean Woody Plant Density (stems/$50m^2$)
For The Sagebrush - 1 (SG-1) Vegetation Type
New Horizon 2 Permit Expansion Study Area, 1999
(n=30)

SPECIES	MEAN DENSITY (STEMS/$50M^2$)			
Artemisia tridentata ssp. tridentata	17.00			
Atriplex canescens	0.20			
Juniperus osteosperma	0.03	s	#/ac	#/ha
Total	**17.23**	**2.34**	**2,517**	**6,292**

Minimum sample size required (n_{min})= 2 (based on total density)

The sagebrush vegetation type as identified within the study area occurs on shallow soil that occurred predominantly in map units 98C and 98D. The native vegetation on these soils is typically a pinyon-juniper dominated woodland or a shrub dominated rangeland. As evidenced by the cover data, and verified by field observations, the pinyon-juniper woodland overstory has been essentially removed. The removal of this overstory plus the level of disturbance associated with livestock use and man's impact has completely altered the composition of the site. Impacts include occasional chaining, and chemical spraying to reduce sagebrush plus poor cattle management practices that has led to most desirable plant species being removed. In evaluating the Guide for Determining Forage Condition attached to the Pinyon-Juniper Woodland Site Description, it is apparent that the sites would only warrant a poor forage condition rating. Note that no woodland site index information has been provided in the Site Description. The stocking rate for the sagebrush type is estimated at a low 0.09 AUM's/ac or 12 acres/AUM assuming use of all grasses and the more palatable forbs.

As stated earlier, the sagebrush-1 type represents a remnant native community that has been severely altered because of intensive agricultural land use and associated support activities. Though these sites normally have a pinyon-juniper tree overstory (previously discussed), these have most likely been removed for fencing materials, firewood, land clearing, and from the impacts of high concentrations of grazing animals. Most of the type occurs where it is impractical to irrigate. The pastures are usually heavily stocked at least during part of the year, resulting in a high level of animal pressure from grazing and trampling. The sites are also periodically used as equipment parking, storage, or boneyard areas and winter livestock feeding areas. The shallow soils, rock outcrops, and low natural precipitation, further reduce the potential productivity of the site, while increasing the potential for further deterioration and decreasing the opportunity for any recovery. The majority of species encountered during cover sampling (see Table 2.04.10-21) were increaser or invader species. Consistent with the composition of severely deteriorated native plant communities in the Great Basin and Colorado Plateau regions, cheatgrass, sagebrush, four-wing saltbrush, and broom snakeweed accounted most of the vegetative cover.

The type is not an important component when considering the local land use and management objectives. Conversion to a higher or better use would be done if not for the militating site conditions and associated costs.

6.6 Sagebrush - 2 Type (SG-2) The sagebrush-2 vegetation type represents remnants of native rangeland that has not been converted to the more characteristic intensive agricultural land uses in the area. This type occurs on toe slopes of mesa sides with slopes ranging 5 to 30 percent. Sagebrush ranged in height 3 ft. to 9 ft. with and average height of 6 ft. Associated with the sagebrush were the shrubs rubber rabbitbrush and four-wing saltbrush. Understory plants are typical of rangeland plants found in the sagebrush-1 type except where irrigation water had run onto the site. In these situations, the understory is dominated with Russian knapweed.

Total vegetation cover (first hit) for the type averaged 56 percent, with bare ground at 7.6 percent, litter at 32.8 percent, and rock outcrop and rock fragments at 3.6 percent (Table 2.04.10-24). Lichen and moss accounted for 0.2 percent of the mean cover. The shrub component dominated with 45.4 percent cover and the annual grass component at 6.5 percent cover. Perennial grasses and forbs at 1.6 and 1.6 percent cover, respectively. Consistent with the type designation, Basin big sagebrush (Artemisia tridentata ssp. tridentata) had the highest perennial species cover at 36.9 percent (85 percent frequency), followed by rubber rabbitbrush with cover at 8.5 percent (35 percent frequency) while the ubiquitous invader of sagebrush rangelands, cheatgrass (Anisantha tectorum) had a cover of 6.5 percent (44 percent frequency). Russian knapweed had a cover of 0.2 percent (10 percent frequency) where irrigation runoff was present. The remaining species generally contributed less than one percent cover to the mean total vegetative cover.

Total herbaceous production (including shrubs) totaled 138.5 g/m2 or 1236 pounds/acre (Table 2.04.10-25). Herbaceous production without the shrub component totaled 19.2g/m2 or 171 pounds/acre. The perennial shrub component contributed the highest value at 119.3 g/m (1065 pounds/acre) followed by annual grass at 10.2 g/m^2 (91 pounds/acre). While the contribution of perennial grasses and forbs was (2.2 and 6.8 g/m^2, respectively). In order to sample the perennial species at the peak of their production, many of the earlier maturing annual species were senescent or were already gone from the stand. Thus the annual grass production is likely higher than stated.

Woody plant density measurements in 1999 differed from 1987 as suffruticose species were not measured consistent with Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining. Succulents were also not included in the density calculations.

Mean density for the type was 37.7 stems/50m2 or 3,015 stems/acre (Table 2.04.10-26). Sagebrush dominated

Table 2.04.10-24
Mean Cover (percent) And Frequency Values For The Sagebrush - 2
Vegetation Permit Expansion Study Area, 1999

SPECIES	MEAN PERCENT COVER (N=55)	FREQUENCY
Annual Grasses		
Anisantha tectorum	6.5	44
Total Annual Grasses	**6.5**	**--**
Perennial Grasses		
Agropyron smithii	0.5	04
Bouteloua gracilis	0.2	02
Bromopsis inermis ssp. inermis	0.5	02
Poa pratensis	0.2	02
Sitanion longifolium	0.2	13
Total Perennial Grasses	**1.6**	**--**
Annual/Biennial Forbs		
Descurainia richardsonii ssp. incisa	<0.1	02
Grindelia squarosa	0.7	04
Total Annual/Biennal Forbs	**0.7**	**--**
Perennial Forbs		
Artemisia ludoviciana	0.7	05
Cirsium Arvense	0.5	05
Centaurea repens	0.2	10
Sonaeralcea coccinea	0.2	02
Total Perennial Forbs	**1.6**	**--**
Shrubs		
Artemisia tridentata	36.9	85
Atriplex canescens	<0.1	2
Chrysothamnus nauseosus	8.5	35
Total Shrubs	**45.4**	**–**
Lichen and Moss		
Moss	0.2	02
Total Lichen and Moss	**0.2**	**--**

Minimum Sample size required (n_{min})= 30 (based on total living cover)

Table 2.04.10-25
Mean Herbaceous Production (g/m^2) Values
For The Sagebrush - 2 (SG-2) Vegetation Type
New Horizon 2 Permit Expansion Study Area, 1999

MORPHOLOGICAL CLASS	MEAN PRODUCTION (G/M^2) (n=50)		
Perennial Shrubs	119.3		
Perennial Grasses	2.2		
Perennial Forbs	6.8		
Annual Grasses	10.2		
Annual Forbs	0.00		
Total	138.5		
	s	lbs/ac	kg/ha
(with P. Shrubs)	54.53	1236	1384
(Without P. Shrubs)	17.63	171	191

Minimum Sample size required (n_{min})= 322 (based on total production)
Minimum Sample size required (n_{min})= 34 (based on total production less P. shrubs)

Table 2.04.10-26
Mean Woody Plant Density (stems/50m^2)
For The Sagebrush - 2 (SG-2) Vegetation Type, New Horizon 2 Permit Expansion Study Area, 1999

SPECIES	MEAN DENSITY (STEMS/50M^2) (n=30)			
Artemisia tridentata	32.1			
Atriplex canescens	0.4			
Chrysothamnus nauseosus	5.1			
Juniperus osteosperma	0.1	s	#/ac	#/ha
Total	**37.7**	2.26	3,015	7,538

Minimum sample size required (n_{min})= 2 (based on total density)

with an average density of 32.1 stems/50m2 or (2,570 stems/acre). Rubber rabbit was the next dominant shrub with 5.1 stems/50m2 or (407 stems per acre). Other species included Utah juniper with 0.1 stems/50m2 or (5 stems/acre) and four-wing saltbush with 0.4 stems/50m2 or (34 stems/acre).

Seventeen species occurred in the cover samples. Three species had relative cover values of 1 percent or greater. Grasses (including annuals) comprised six of the species (see Table 2.04.10-24), while annual/biennial/perennial forbs totaled six. Three shrubs occurred in the cover samples, as did lichen and moss.

The sagebrush -2 (SG-2) vegetation type as identified within the study area occurs on soil map unit 98G. The map unit is comprised of Bowbac and Bowdish soil. Within the complex are small inclusions of coal. Bowbac is typically a big sagebrush range site and Bowbac is typically a pinon-juniper range site. As evidenced by the cover data, and verified by field observations, the pinyon-juniper woodland overstory has been essentially removed if it existed at all. The removal of this overstory plus the level of disturbance associated with livestock use and man's impact has completely altered the composition of the site. In evaluating the Guide for Determining Forage Condition attached to the Pinyon-Juniper Woodland Site Description, it is apparent that the sites would only warrant a poor forage condition rating. Note that no woodland site index information has been provided in the Site Description. . The stocking rate for the sagebrush type is estimated at a low 0.09 AUM's/ac or 12 acres/AUM assuming use of all grasses and the more palatable forbs.

As stated earlier, the sagebrush-2 (SG-2) type represents a remnant native community that has been severely altered because of intensive agricultural land use and associated support activities. Most of the type occurs on toeslopes of a mesa adjacent to the alluvial flood plain of Tuttle Draw. The sites are heavily stocked with cattle at least during part of the year, resulting in a high level of animal pressure from grazing and trampling and winter livestock feeding areas. Consistent with the composition of severely deteriorated native plant communities in the Great Basin and Colorado Plateau regions, cheatgrass predominated the understory while more desirable range species were lacking. Tail water from leaking ditches on the mesa top encroaches this type. Where tailwater is present the site is dominated with an understory of Russian knapweed.

The type is not an important component when considering the local land use and management objectives. Conversion to a higher or better use would be done if not for the militating site conditions and associated costs.

6.7 Deciduous Trees (DT) Approximately seven acres of exotic and deciduous trees have invaded a north facing mesa sideslope that was originally dominated with pinon - juniper on the Martin property. The deciduous tree invasion is due solely to runoff from irrigated lands on the mesa top. Slopes range 30 to 60 percent and soil is shallow to moderately deep. Soils are represented in soil map unit 98B. Besides a few remnant pinon (2 percent) and Utah juniper (5 percent), the site is dominate with elm (30 percent), Fremont's cottonwood (15 percent), boxelder (5 percent), Hawthorne (4 percent) and locust (10 percent). The understory has Rosa Nutans, Kentucky bluegrass, clematis, smooth brome, orchard grass, western wheatgrass, along with those species commonly associated with the sagebrush sites. This area will only incur no disturbance.

6.8 Pinon - Juniper (PJ). A small area of 1 acre of Pinon - Juniper exists on a small area of north facing mesa sideslopes belonging to WFC. The site is dominated with pinon and Utah Juniper and plants commonly found in the sagebrush - 1 site. The understory is comprised of blue grama, galleta, bottlebrush squirreltail, snakeweed, four-wing saltbrush, cheatgrass, and rubber rabbit brush. This area will incur no disturbance.

6.9 Rangeland - Flood Plain (FP) The bottom of Tuttle draw has a flood plain that varies in width from 20 meters to 100 meters. The flood plain is comprised of two parts, the channel bank which is 1 to 3 meters in width and the alluvial terrace which is 20 to 100 meters wide. Soil map unit 98A is representative of the alluvial terrace soil. The flood plain type resides wholly outside the area of disturbance.

6.10 Farmsteads, Orchards, Facilities and Other Types The remainder of the study area includes farmsteads, orchards, roads, ponds, irrigation ditches, and disturbed areas primarily near the farmsteads. Because of the intensity of activity in the area, the number of operators within the study area, and the length of time that these activities have been ongoing in the area, a portion of the study area is included within this category (approximately 5.7 percent of the study area and 5.3 percent of the disturbance area).

There are three active farmsteads or homesites within the study area and four inactive or abandoned farmsteads or homesites. Only Morgan, Johnson and Martin currently live within the permit boundary. Johnson has actually sold his property to WFC and will leave once mine operations begin. The size of these farmsteads range from over three acres down to less than one acre and include buildings, yards, corrals and other support facilities. Only the Johnson property occurs on the better soil and more gentle topography of the study area. The remainder are located on poorer soils that tend to be rocky and moderately deep to shallow, though the topography tends to be relatively gentle. Vegetation in these areas consists of a variety of annual and perennial exotic species, as well as remnant examples of the native plant populations. Dominating the vegetation are large native and exotic shade trees, as well as ornamental and exotic shrubs. A detailed survey for herbaceous species was not conducted in the farmstead areas because of the numerous garden, ornamental, and other exotic species normally found in these areas and the fact that these areas will be reclaimed as irrigated pasture.

Two abandoned orchards occur within the study The dominant species in these orchards is apple (Malus sylvestris), with peach (Prunus persica) and apricot (Prunus armeniaca) also occasionally present. The orchards were established by Johnson and Morgan mostly for family consumption and are located adjacent to the farmsteads. The trees still yield fruit but are no longer managed for fruit production. The understory is predominated by herbaceous species such as orchard grass, smooth brome, Kentucky bluegrass, quackgrass, plantains, and dandelion.

Disturbed areas, a rather self descriptive term, included areas with heavy animal concentrations, mechanical disturbance due to equipment operation, trash dumps, homestead coal mining, and waste ground associated with various agricultural and support activities.

Ponds and irrigation ditches of various capacities are scattered throughout the study area. A large lateral ditch (West Lateral CC Ditch) runs through the study area, while several smaller lateral ditches deliver water to the various irrigated fields, pastures and hay fields in the study and permit area (see Section 2.04.7, Hydrology Description). The vegetation in or near these ditches is dominated by many of the species that occur in the swale and irrigation pasture vegetation types. Cottonwoods, box elder, cattails, and willows are prominent components of

the vegetation associated with these ditches, while the dense cover of graminoid and occasional forb species protect the banks of the ditches from erosion. A total of 9 ponds occur within the study area. Ponds are maintained to catch irrigation and storm runoff water for livestock use. All operators stated that the ponds were not associated with any irrigation systems or water storage for that purpose. The vegetation around these ponds is similar to that found in the swale type and along the irrigation ditches.

Soil map units 98A, 98D, 98E, 98F and 98G have a sagebrush-grassland potential native plant community characterized by the Semidesert Loam Range Site. This Range site is described in the 1987 study within this document.

Soil Map units 98C, 98B, and 98H have a pinyon-juniper woodland potential native plant community characterized by the Pinyon-Juniper Woodland Site Description. This Range site is described in the 1987 study within this document.

The following areas are outside the permit area.

6.11 Channel Bank The channel bank is directly adjacent to the Tuttle Draw water surface. It is continually saturated with water and supports a variety of native and introduced hydrophytic graminoids and forbs. Closest to the stream, the bank is lined with scirpus (Scirpus americana). Intermingled and moving away from the bank, are rushes and sedges (typically Carex nebrascensis and Carex occidentalis) along with horsetail (Equisetum kansanum), salt grass (Disticlis stricta) and alkali sacatone (Muhlenbergia asperfolia). In some areas coyote willow (Salix exigua) and saltcedar (Tamarisk sp.) predominate. The channel also has a few cottonwoods (Populus fremontii and Populus longifolia) and Russian olive. Intoduced species have also invaded the channel bank. The species include alfalfa, Russian knapweed, milkweed. Plantain (Plantago lanceolata), Yellow and white honeyclover

6.12 Alluvial Terrace The alluvial terrace is comprised of sands, loamy sands and sandy loam deposited by major flood events. The terrace is 1 to 5 meters above the stream channel and is dry at the surface but receives subsurface moist from the stream. The alluvial terrace has had varying degrees of human activity. The most intensively managed parts of the alluvial terrace are an irrigated hayland pasture owned by Johnson and irrigated pastures owned by Martin and Lloyd. The majority of the alluvial terrace have had disturbances with the removal of native sagebrush, rubber rabbitbrush, four-wing saltbrush and greasewood. Abandoned areas have been reinvaded with these species along with Russian knapweed, Lappula, burdock, cheatgrass and pricly pear cactus. The remaining native trees are Fremonts cottonwood and longleaf cottonwood. Russian olive has invade along with saltcedar in a few areas.

6.13 Sagebrush Reference Area This reference area was established in the initial permitting of the mine and is to be replaced by the new dryland pasture reference area. In agreement with the CDMG, it was tested in the1999 sampling program. The sagebrush reference area represents remnants of native rangeland that has not been converted to the more characteristic intensive agricultural land uses in the area. The sagebrush reference area is located at SW1/4, NE1/4, Sec. 36, T.47N., R.16W. Between the old Peabody Site to the north

and New Horizon Mine II study area to the south. Soil is similar to study area soil map unit 98C and the vegetation is similar to the sagebrush-1 (SG-1) in the study area.

Total vegetation cover (first hit) for the type averaged 36.0 percent, with bare ground at 32.5 percent, litter at 19.9 percent, and rock outcrop and rock fragments at 11.6 percent (Table 2.04.10-27). Lichen and moss accounted for 4.6 percent of the mean cover. The shrub component dominated with 14.4 percent cover followed by the perennial grass component at 11.9 percent cover. Annual grasses account for 4.1 and 2.6 percent cover. Succulents had 0.1 percent cover and trees had 0.9 percent cover. Consistent with the type designation, sagebrush (Artemisia tridentata) had the highest perennial shrub species cover at 12.2 percent (68 percent frequency), followed by broom snakeweed with cover at 1.9 percent (8 percent frequency). The perennial grass blue grama had 7.4 percent cover (33 percent frequency) and needlegrass with

Table 2.04.10-27

Mean Cover (percent) And Frequency Values

For Sagebrush Reference Area,

New Horizon 2 Permit Expansion Study Area, 1999

SPECIES	MEAN PERCENT COVER (N=75)	FREQUENCY
Annual Grasses		
Anisantha tectorum	4.1	22
Total Annual Grasses	4.1	--
Perennial Grasses		
Bouteloua gracilis	7.4	33
Hilaria jamesii	0.5	03
Oryzopsis hymenoides	0.1	01
Sitanion longifolium	0.9	06
Stipa neomexicana	2.9	9
Total Perennial Grasses	**11.7**	**--**
Shrubs		
Artemisia tridentata	12.2	29
Atriplex canescens	0.4	01
Gutierrezia sarothrae	1.9	08
Total Shrubs	**14.4**	**--**

Trees		
Pinus edulis	0.9	01
Total Trees	**0.9**	**--**
Succulents		
Opuntia polyacantha	0.1	01
Total succulents	**0.1**	**–**
Lichens and Moss		
Moss	2.3	10
Lichen	2.3	16
Total Moss and Lichen	**4.6**	**–**

Minimum Sample size required (n_{min})= 23 (based on total living cover)

Table 2.04.10-28

Mean Herbaceous Production (g/m^2) Values

For The Sagebrush Reference Area,

New Horizon 2 Permit Expansion Study Area, 1999

(n=30)

MORPHOLOGICAL CLASS	MEAN PRODUCTION (G/M^2)
Perennial Shrubs	19.1
Perennial Grasses	13.7
Perennial Forbs	0.9
Annual Grasses	1.1
Annual Forbs	0.00
Total	**34.8**

	s	lbs/ac	kg/ha
(with P. Shrubs)	17.4	308	345
(Without P. Shrubs)	12.51	137	154

Minimum Sample size required (n_{min})= 88 (based on total production)

Minimum Sample size required (n_{min})= 47 (based on total production less P. shrubs)

Table 2.04.10-29

Mean Woody Plant Density (stems/50m^2)

For The Sagebrush Reference Area,

New Horizon 2 Permit Expansion Study Area, 1999

(n=30)

SPECIES	MEAN DENSITY (STEMS/50M^2)			
Artemisia tridentata	25.8			
Atriplex canescens	1.3			
Pinus edulis	0.1	s	#/ac	#/ha
Total	**27.2**	**2.93**	**2,149**	
5,372				

Minimum sample size required (n_{min})= 3 (based on total density)

2.9 percent cover (9 percent frequency). Cheatgrass (Bromus tectorum) had 4.1 percent cover (22 percent frequency). Lichen cover was 2.3 percent (16 percent frequency) and moss cover was 2.3 percent (10 percent frequency). The remaining species generally contributed less than one percent cover to the mean total vegetative cover. Total herbaceous production (including shrubs) totaled 34.5 g/m2 or 308 pounds/acre (Table 2.04.10-28). Herbaceous production without the shrub component totaled 15.4 g/m2 or 137 pounds/acre. The perennial shrub component contributed the highest value at 19.1 g/m (170 pounds/acre) followed by 0.9 g/m^2, respectively). In order to sample the perennial species at the peak of their production, many of the earlier maturing annual species were senescent or were already gone from the stand. Thus the annual grass production is likely higher than stated.

Woody plant density measurements in 1999 differed from 1987 as suffruticose species were not measured consistent with Guidelines for Compliance with Land Use and Vegetation Requirements for Coal Mining. Succulents were also not included in the density calculations. Mean density for the type was 27.1 stems/50m2 or 2,149 stems/acre (Table 2.04.10-29). Sagebrush dominated
with an average density of 25.8 stems/50m2 or (2,067 stems/acre). Four-wing saltbush was the next dominant shrub with 1.3 stems/50m2 or (102 stems per acre). Pinon had 0.1 stems/50m2 or (5 stems/acre).

Twelve species occurred in the cover samples. Five species had relative cover values of 1 percent or greater. Grasses (including annuals) comprised six of the species (see Table 2.04.10-27). Three shrubs occurred in the cover samples, as did one lichen, one moss, one succulent and one tree.

The sagebrush reference area is not being utilized for comparison to the amended area dryland pasture. The sagebrush reference area has been abandoned for a dryland pasture reference area near the Nucla airport which is typical of a dryland pasture in the area.

6.14 Dryland Pasture Reference Area The original dryland pasture reference area was established in 1999 (in combination with the rangeland reference area) to more closely approximate land uses that will occur in the post mine phase where land is returned to dryland pasture. Previous to this area, the Sagebrush Reference Area north of the New Horizon 2 Mine was used for dryland pasture and rangeland. The new area was jointly observed by Dan

Matthews of the CDMG and Jim Irvine and was deemed more appropriate for evaluating the reclaimed dryland pasture than the existing sagebrush reference area.

The new site became known as the 1999 Reference Area, which was located on a site west of the Nucla-Naturita Airport (see Attachment 2.04.10-1 Location of Reference Areas). The site was selected as a replacement for several reasons. First, the land is owned by the Bureau of Land Management (BLM). The BLM was willing for WFC to establish a 3 acre dryland pasture reference area adjacent to their existing dryland pasture reference area in exchange for sharing data on the site. WFC agreed to share whatever data they collected with the BLM. Secondly, the selected site was on a mesa top similar to the New Horizon II permit expansion study area. Most of the mesa had been chained, plowed, disked and seeded to crested wheatgrass (Agropyron cristatum) approximately 25 years ago. The crested wheat was well established and has recieved only light to moderate grazing pressure according to the BLM and the permitee (Zene Wiemer). The site also is at approximately the same elevation and receives the same precipitation as the study area. For the 1999 study period, the BLM reference plot was sampled for cover, production and woody stem density. The BLM agreed to allow 10 randomly placed 1 square meter range enclosure cages to be placed on the site for future reference and sampling. The dryland reference area occurs on shallow soils similar to those found in soil map unit 98C. In 1999, no cattle grazing had occurred according to BLM and the Permittee. All grazing up to the time of sampling was by wildlife.

Total vegetation cover (first hit) for the type averaged 24 percent, with bare ground at 51 percent, litter at 21.6 percent, and rock fragments at 3.4 percent (Table 2.04.10-30). Lichen and moss accounted for 0.1 percent of the mean cover. The perennial grass component dominated with 23.2 percent cover and the annual grass component at 0.2 percent cover. Shrubs had 0.6 percent cover. Consistent with the type designation, crested wheatgrass (Agropyron Cristatum) had the highest perennial species cover at 22.8 percent (96 percent frequency). The remaining species generally contributed less than one half percent cover to the mean total vegetative cover.

Herbaceous production totaled 50.03 g/m2 or 447 pounds/acre with shrubs and 47.77 g/m2 or 436 pounds/acre without shrubs (Table 2.04.10-31). The perennial grass component contributed the highest value at 47.5 g/m (424 pounds/acre) followed by perennial shrubs at 1.3 g/m^2 (11.2 pounds/acre). The contribution of annual grasses and perennial forbs was (1.1

and 0.2 g/m^2, respectively). Actual contribution to annual production is most likely higher. In order to sample the perennial species at the peak of their production, many of the earlier maturing annual species were senescent or were already gone from the stand.

Table 2.04.10-30
Mean Cover (percent) and Frequency Values
For The Dryland Pasture Reference Area (dpr)
New Horizon 2 Permit Expansion Study Area, 1999

SPECIES	MEAN PERCENT COVER (N=50)	FREQUENCY
Annual Grasses		
Anasantha tectorum	0.2	02
Total Annual Grasses	**0.2**	**--**
Perennial Grasses		
Agropyron cristatum	22.8	96
Bouteloua gracilis	00.4	04
Total Perennial Grasses	**23.2**	**--**
Shrubs		
Ephedra viridis	0.6	04
Total Shrubs	**0.6**	**--**

Minimum Sample size required (n_{min})= 6 (based on total living cover)

Table 2.04.10-31
Mean Herbaceous Production (g/m^2) Values
For The Dryland Pasture Reference Area
New Horizon 2 Permit Expansion Study Area, 1999
(n=30)

MORPHOLOGICAL CLASS	MEAN PRODUCTION (G/M^2)
Perennial Shrubs	1.26
Perennial Grasses	47.51
Perennial Forbs	0.18
Annual Grasses	1.08
Annual Forbs	0.00
Total	**50.03**

	s	lbs/ac	kg/ha
(with P. Shrubs)	5.40	447	500
(Without P. Shrubs)	5.13	436	488

Minimum Sample size required (n_{min})= 9 (based on total production)
Minimum Sample size required (n_{min})= 8 (based on total production less P. shrubs)

Table 2.04.10-32
Mean Woody Plant Density ($stems/50m^2$)
For The Dryland Pasture Reference Area,
New Horizon 2 Permit Expansion Study Area, 1999
(n=30)

SPECIES	MEAN DENSITY ($STEMS/50M^2$)			
Artemisia tridentata	0.24			
Ephedra viridis	0.18	s	#/ac	#/ha
Total	**0.42**	**0.32**	**34**	**85**

Minimum sample size required (n_{min})= 2 (based on total density)

Woody plant density measurements in 1999 differed from 1987 as suffruticose species were not measured consistent with Guidelines for Compliance with Land Use and Vegetation

Requirements for Coal Mining. Succulents were also not included in the density calculations. Mean density for the type was 0.42 stems/50m2 or 34 stems/acre (Table 2.04.10-32). Sagebrush dominated with an average density of 0.24 stems/50m2 or (19 stems/acre). Mormon tea was the next dominant shrub with .18 stems/50m2 or (15 stems per acre).

The dryland pasture vegetation type as identified occurs on soils similar to soil map unit 98C in the study area. Sagebrush, Mormon tea, blue grama, and cheatgrass have invaded the site since it was planted to a mono-culture of crested wheatgrass. This invasion over the last 25 years has been low however as evidenced by shrub woody stem density of 34 stems/acre and shrub production of only 22 pounds/acre. This data is consistent with field observations which show that the invaders are small and scattered. Production of 447 pound/acre is also consistent for this type within this precipitation/elevation zone over shallow soil.

The original dryland pasture reference area, established in 1999 west of the airport, was originally a pinon-juniper/ sagebrush range site consisting of scattered pinon and juniper. Under story consisted primarily of sagebrush, four-wing saltbush, blue grama and galleta.

Unfortunately, in early 2000, WFC discovered that heavy cattle grazing had been allowed to occur on the original dryland reference area west of the airport and that there was no guarantee that heavy grazing could be prevented from occurring again in the foreseeable future. Consequently, WFC proposed a new reference area (in combination with the rangeland reference area) within the fenced perimeter of the nearby Montrose County owned and operated Hopkins Field airport, where grazing was prohibited. CDMG approved this combined rangeland/dryland pasture reference area at the airport in 2000 after conducting a field inspection of the area and reviewing vegetation data submitted in bond release application SL-07. This combined rangeland/dryland reference area at the airport was approved in Permit Renewal RN-04. This reference area is known as the 2000 Reference Area and is shown on the map in Attachment 2.04.10-1.

In 2004, early scoping work by Hahn Environmental Consultants indicated the combined rangeland/dryland pasture reference area at the airport contained too many shrub species for making a valid comparison with the reclaimed dryland pasture areas on NH1 and NH2. Consequently, in 2005 WFC proposed to separate the dryland pasture reference area from the

combined area by establishing a new dryland reference on 6.8 acres approximately 20 feet east of the combined area. (A 20-foot strip of land separates the two areas because it has been used as a roadway.) CDMG required a study to verify the proposed separate dryland reference area was statistically similar to the combined reference area. TR-53 established the separate dryland reference in 2005, with the former combined area to continue to serve only as the rangeland reference area. Attachment 2.04.10-1 shows the general locations of all previous and current reference areas and also shows the detailed location of the current separate rangeland and dryland reference areas. Attachment 2.04.10- 4 is the report on the comparison study done by Bio-Logic Environmental for the 2000 and 2005 in-airport reference areas. The report conclusion states that "because total cover and production at the two sites are very similar, and the sites are similar in other respects, the new airport reference area appears to be an acceptable reference area for the dryland pasture type". This area is now known as the 2005 Reference Area.

6.15 Irrigated Pasture Reference Area

Up to Technical Revision 58 of 2009, the standards for revegetation of Irrigated Pastureland were based on written letters from the nearby farmers in 1998 based on their recollection of average production from the irrigated pasture fields. The standard was 90% of 1.5 tons per acre for the 1st cutting. It is hardly scientific and is vulnerable to yearly problems with variation in ditch flows, precipitation, etc. TR 58 established an irrigated pasture reference area immediately southeast of the permit area, on land that is flood irrigated with the same ditch as the reclaimed area. The area is 6.81 acres and will utilize 10 shares of water. WFC has employed the same management company for the reference area as the reclaimed area.

A detailed method has been established to account for differences in soil type between the reference area and the reclaimed irrigated pasture areas for bond release. This is discussed in detail in Section 2.05.4(2)(e) Revegetation. Also, all detailed procedures for measurement and evaluation of the reference area as well as the reclaimed areas are included in Section 2.05.4(2)(e) Revegetation.

7.0 Summary of Pre-Mine Vegetation Areas

For Permit Revision 06 in 2009, a slight change to the permit boundary was made, resulting in a new total permit area of 827.44 acres. Also, as mentioned previously in this section, there were a number of tracts that were re-classified due to the prime farmland soils designation in 2008. There were other practical changes in naming of the areas. All updated vegetation types are shown on the revised Map 2.04.10, which also now has the aerial image of the area from 1998. The vegetation types are the same as the pre-mine land use types, which are shown on Map 2.04.3.

A summary of the revised vegetation and land use types is included on the following page. These are the same as the land use areas outlined in Section 2.04.3.

Table 2.04.10-33 Pre-Mine Vegetation (Land Use) Acreage Summary and % of Total

Land Status Category	Acres	% of Total Acres
Cropland - Irrigated Orchards (ICO)	0.89	0.11
Cropland - Irrigated Alflafa Hay (IC)	47.87	5.79
Cropland - Irrigated Small Grain (ICSG)	25.06	3.03
Total Cropland	**73.82**	**8.92**
Pastureland - Irrigated Hay (IPH)	159.76	19.31
Pastureland - Irrigated Grass (IP)	322.10	38.93
Pastureland - Irrigated Swale (IPSW)	75.42	9.11
Total Pastureland	**557.28**	**67.35**
Rangeland - Sagebrush (original) (SG)	25.64	3.10
Rangeland - Sagebrush -1 (SG-1)	81.29	9.82
Rangeland - Sagebrush -2 (SG-2)	16.44	1.99
Rangeland - Deciduous Trees (DT)	6.70	0.81
Rangeland - Floodplain (FP)	9.92	1.20
Rangeland - Pinyon Juniper (PJ)	1.15	0.14

Total Rangeland	**141.14**	**17.06**
Commercial - Roads (R)	11.88	1.44
Total Commercial	**11.88**	**1.44**
Residential - Farmsteads (F)	20.65	2.50
Residential - Open Space Disturbed (D)	18.36	2.22
Total Residential	**39.01**	**4.71**
Developed Water Resources - Stock Ponds (P)	4.31	0.52
Total Developed Water Resources	**4.31**	**0.52**
TOTAL	**827.44**	**100.00**

Literature Cited

ASCS. 1988. Personal communication, Agricultural Stabilization and Conservation Service (ASCS), Montrose, Colorado. August, 1988.

Beetle, A.A. 1970. Recommended Plant Names. Univ. Wyo. Agric. Exp. Sta. Res. Journal Laramie.

Brown, D.E. and R. M. Turner. 1982. Great Basin Conifer Woodland and Great Basin Desertscrub. In: Biotic Communities of the American Southwest - United Stated and Mexico; David E. Brown, Editor. Desert Plants, Vol. 4, No. 1-4, University of Arizona Press, Tucson.

Buckner, D.L. 1985. Point-intercept cover techniques in revegetation studies: maximizing objectivity and repeatability. In: (Fisher, S.E. and D. Williams, co-chairmen) Proceedings of the Second Annual Meeting of the American Society for Surface Mining and Reclamation. October 8-10, 1985. Denver, CO.

Chambers, J.C. 1983. Measuring species diversity on revegetated surface mines: An evaluation of techniques. USDA For. Serv. Res. Pap. INT-322. Int. Mt. For. and Range Exp. Sta., Ogden, Utah.

Cox, G.W. 1976. Laboratory Manual of General Ecology. William C. Brown Co., San Diego, CA.

Heath, M.E., R.F. Barnes and D.S. Metcalfe. 1985. Forages, the Science of Grassland Agriculture (Fourth ed.). Iowa State University Press, Ames, Iowa. 643 p.

Hermann, F.J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. USDA Agric. handbook No. 374.

Hermann, F.J. 1975. Manual of the rushes (Juncus spp.) of the Rocky Mountains and Colorado Basin. USDA For. Serv. Gen. Tech. Rep. RM-18. Rocky Mt. For. and Range Exp. Stn., Fort Collins, CO.

ITIS. 1998. Integrated Taxonomic Information System. NRCS.

Johnson, James. Personal communication, local resident, May 1987.

Kuchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States (map, 2nd ed.). American Geographical Society, Special Publication No. 36. American Geographical Society, New York. Morgan, F. 1988. Personal communication, local Nucla farmer, August, 1988.

Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, Inc., New York. NOAA. 1987. National Oceanic and Atmospheric Administration Climatological Data, Colorado. Vol. 92, Nos. 1-10.

Nickersen, M.F., G.E. Brink, and C. Feddema. 1976. Principle range plants of the central and southern Rocky Mountains: Names and symbols. USDA For. Serv. Gen. Tech. Rep. RM-20. Rocky Mt. For. and Range Exp. Stn., Fort Collins, CO.

NRCS . PLANTS National Database 1997.

NRCS Western Regional Climate Center. 1999. Portland Oregon, Precipitation Data for San Miguel Basin.

NOAA. 1999. Climate data for Uravan, Colorado

Schumaker, G.A., C.W. Robinson, W.D. Kemper, H.M. Golus, and M. Amemiya. 1967. Improved soil productivity in western Colorado with fertilizers and alfalfa. Colorado State University Agricultural Experiment Station Technical Bulletin 91. 52 p.

Soil Conservation Service (SCS). No date. Soil Survey of San Miguel Area, Colorado. Unpublished.

Stewart, W.G. 1973. Irrigated pastures for Colorado. Colorado State University Cooperative Extension Service Bulletin 469A. 28 p.

U.S. Soil Conservation Service (SCS). 1985. Colorado Technical Guide Section IV, Standard and Specification #510, Pasture and Hayland Management.

U.S.Soil Conservation Service (SCS). 1979. Common plant names list and scientific plant names list. Exhibit 407.1(a)(b). National Soils Handbook, Part II. USDA, Washington, D.C.

Viert, S.R. 1985. A new instrument for measuring ground cover based on the point-hit technique - the optical point bow. I--n: (Fisher, S.E. and D. Williams, co-chairmen) Proceedings of the Second Annual Meeting of the American Society for Surface Mining and Reclamation. October 8-10, 1985. Denver, Co.

Weber, W.A. 1987. Boulder. CoLorado F1ora: Western SLope. Colorado Associated University Press,

Weimer, Z. 1988. Personal communication, local Nucla farmer. August 1988 and 1999.

Attachment 2.04.10-1

Location of Reference Area

Attachment 2.04.10-2

Detailed Location of Reference Area

Attachment 2.04.10-3

Sampling Data Summary

Attachment 2.04.10-4

Comparison between the 2000 and 2005

Airport Reference Areas

Attachment 2.04.10-5

Old Peabody Appendix 10-1

Attachment 2.04.10-6

Old Peabody Appendix 10-2

Attachment 2.04.10-7

Old Peabody Appendix 10-3

Attachment 2.04.10-8

Old Peabody Appendix 10-4

Attachment 2.04.10-9

Old Peabody Attachment 9-5

Attachment 2.04.10-10

Old Peabody Addendum 11-1