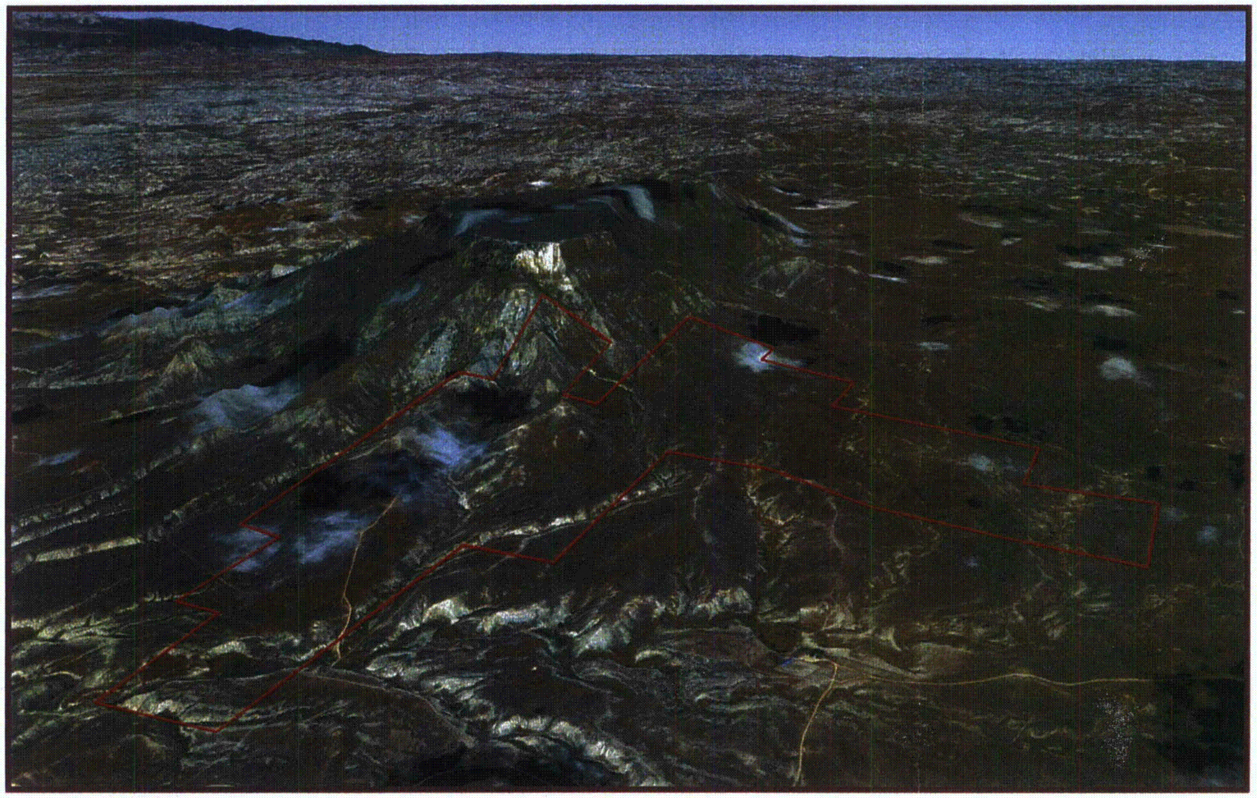
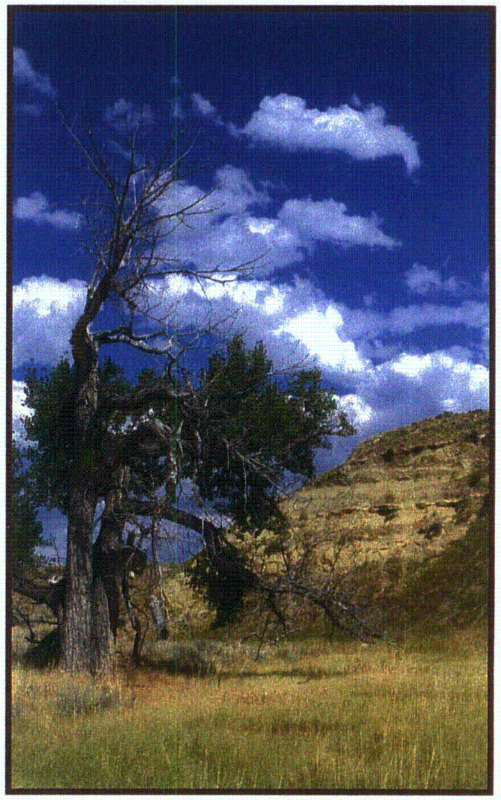
POWER RESOURCES, INC.
dba CAMECO RESOURCES
NORTH BUTTE ISR
WDEQ PERMIT NO. 632 UPDATE

Cameco





Lidstone and Associates, Inc.
Engineering, Geology, & Water Resource Consulting

VOLUME 6 OF 6
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APPENDIX D7
SOILS

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APPENDIX D7
SOILS

1.0 SCOPE AND OBJECTIVES

This report presents information on the soils occurring on Power Resources Inc. doing business as Cameco Resources (CR) North Butte permit area. The area has been previously surveyed, on a large scale, by the U.S. Department of Agriculture, Soil Conservation Service (SCS), and, on a smaller scale, by SCS personnel in 1978 and 1979. In order to bring the 1978-79 work up to current standards, additional field work was initiated in 1988. The major objective of both site-specific studies was to define the existing topsoil resource within the survey area and determine the extent, availability, and suitability of soils material for use in reclamation.

This report has been divided into the following additional sections: METHODOLOGY - Review of Existing Information; 1978-79 Soil Survey; 1988 Soil Survey; Soil Sampling, Description and Analysis; Evaluation of Soil Suitability as a Plant Growth Medium in conjunction with quantitative soil analysis; and Topsoil Volume Calculations; RESULTS AND DISCUSSION -including prime farmland and a summary of the features considered to be the most significant to the 1988 study, in conjunction with previous work. Interpretations are based on the information in site-specific series descriptions and mapping unit descriptions, as well as previously published data of the same or similar soils by the Soil Conservation Service.

In October, 1992, Pathfinder incorporated into the permit boundary approximately 50 acres of adjacent lands located along the southern border of the permit area's eastern arm. Soil boundaries for this area added to **Plate D7-1** were taken from soils mapping conducted by Cleveland Cliffs in 1978-79, which covered an area larger than the current permit boundary. As no new soils groups occur within this area, no changes have been made to the following sections.

2.0 METHODOLOGY

2.1 Review of Existing Literature

The soils of this portion of Campbell County have been mapped by the USDA Soil Conservation Service. Although the soil survey has not been published, it is available in "open file form".

Additional soil mapping of the current permit area, with the exception of the proposed access road, was conducted in 1978-79 by a consultant for Cleveland-Cliffs Iron Co. This previous study was used as a basis for the current field work and subsequent report.

2.2 Soil Survey

2.2.1 The 1978-79 Soil Survey

Methodology within this earlier study was in accordance with the standards of the National Cooperative Soil Survey Program. Soils mapping involved the inventory of soil types on the survey area, defining associations and series boundaries by photo-interpretation, and field survey and sampling. Field verification included examination of physical characteristics of the soils to determine depth, color, texture, structure, horizon boundaries, and reaction (presence of lime and approximate pH). Soil mapping unit boundaries were delineated on aerial photographs by SCS personnel and transferred to an aerial photo composite of the permit area at a scale of 1"=500' and corrected for distortion (**Plate D7-1**).

Soil samples were collected during the summer of 1979 for analysis. As requested by Mr. Don Crecilius, WDEQ, sample site locations were selected to adequately represent the soils of the area to be disturbed and taken within those areas. Soil profiles were sampled and categorized in the spring and early summer of 1979 and samples were analyzed according to the parameters outlined in the current WDEQ Guideline I at the time.

Personal contact with SCS personnel, at the time of the earlier work, and follow-up chemical analysis indicated no problems such as excessive salt concentration within the soils of the survey area.

Mapping unit descriptions and profile descriptions for fifteen points including four points sampled for analysis were compiled for the 1978-79 work.

2.2.2 The 1988 Soil Survey

Refinement of the existing soil map in 1988 was accomplished according to techniques and procedures of the National Cooperative Soil Survey. Guideline No. 1 (November, 1984) of the Wyoming Department of Environmental Quality, Land Quality Division was used as a guide during all phases of this latter work.

A reconnaissance of the survey area was used to determine the validity of the previous soil survey and to familiarize the field personnel with the area. Soil profiles were examined on a widely scattered basis according to physiographic configuration. Information derived from these profiles was compared with existing SCS data to determine which soils were likely to occur on specific landscape positions.

Following the reconnaissance survey, a higher intensity soil survey was conducted. Actual soil boundaries were delineated in the field by exposing additional soil profiles to determine the nature and extent of soil series present on the survey area.

The soil boundaries were delineated on the l"=500' scale photo base map (**Plate D7-1**). The previous SCS data for the site was available throughout the field survey.

2.3 1988 Soil Sampling, Description, and Analysis

Per discussions with state personnel, all soils were sampled and described by exposing the solum with a shovel and then sampling below this point with a bucket auger. The physical and, where possible, chemical nature of each horizon within the sampled profile was described and recorded in the field using standard SCS survey techniques. The sampling site was marked in the field with a numbered stake, and its location and number were plotted on the field map. The sampled soil material was placed in clean, labeled, polyethylene plastic bags, and was kept cool and as dry as possible to limit chemical changes. At the end of the sampling program, the samples were transported to Energy Laboratories in Casper for shipment to Billings.

A total of 17 sites were sampled in 1988 for analysis and corresponding soil profile descriptions written. This additional sampling and profile description would supplement the 1978-79 sampling and profile descriptions. Soil mapping unit designations and associated acreages are presented in **Table D7-1**. Soil analysis methods used for this soil sampling program are provided in **Attachment D7-1**.

2.4 Evaluation of Soil Suitability as a Plant Growth Medium

Refer to discussion within 1988 individual profile descriptions.

2.5 Topsoil Volume Calculations

Refer to **Table D7-2**.

2.6 1988 Project Participants

Western Environmental, Inc. performed the 1988 soil survey field work and compiled that information and analysis received from Uranerz. All soil analysis was handled under separate contract by Uranerz.

The soils map associated with this work was submitted to Uranerz for drafting.

3.0 RESULTS AND DISCUSSION

3.1 Soil Survey

3.3.1 The 1978-79 Soil Survey

No general discussion.

3.3.2 The 1988 Soil Survey

The soils occurring on the proposed North Butte permit area are typical of the semi-arid grasslands of the western United States. Due to prevailing climate and vegetation conditions, organic matter is accumulated slowly, and soils have developed with light-colored surfaces. Subsoil color is usually light brown or yellowish brown.

The greatest proportion of the upland soils of the survey area are residual (developed in place) and are formed from weathered sedimentary bedrock, mostly sandstone and shale. Most developed soils reflect the character of the bedrock. Areas of sandy and medium-textured friable soils are underlain by sandstone and sandy shale. Heavy clay soils are underlain by clayey shale. Depending primarily on the parent material from which the soils have formed, these soils vary widely in both depth and suitability of the material for topsoiling.

Stream channels of the survey area are characterized by alluvial soils such as the Kishona (Kim) series. These soils are developed from a variety of material washed from the uplands and redeposited along the stream courses. The soils formed in alluvium reflect the character of the weathered, transported material. These soils often have a generally dark friable surface that contains a fair amount of organic matter.

3.2 Soil Sampling and Analysis

3.2.1 The 1978-79 Soil Survey

Applicable mapping unit descriptions and profile descriptions are provided.

3.2.2 The 1988 Soil Survey

As can be seen in the 1988 profile descriptions and analysis, several of the pH's within the soils sampled were slightly lower than that normally found in the specified soil series. These lower pH values are likely results of geologic conditions within the survey area.

Lab analysis of the 1988 soil samples did not include percent fine sands. This made detailed differentiation between series partially dependent on this value somewhat difficult. However, based on field observations of fine sands within individual peds as well as topographic position and overall lab texture, series designation was determined.

Silt content of some of the samples was higher than expected with the resultant lab textures not specifically matching field textures. Since many of the differences were related to clay content, it is assumed total dispersion of the soil sample may not have been attained.

The sampled Shingle turned out to have higher clay content than that normally defined for the series. Therefore, the sample was labeled Samday (Samsil) and the report adjusted accordingly.

No prime farmland was indicated within the North Butte permit area.

4.0 MAPPING UNIT DESCRIPTIONS

Unit BO Bowbac sandy loam

The Bowbac sandy loam map unit consists of gently sloping to moderately steep, well-drained soils that formed in slopewash alluvium and residuum derived primarily from sandstone. Slopes range from 6 to 15 percent. The vegetation consists of various grasses and big sagebrush.

Included in this unit are small areas of Cushman clay loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used primarily for range.

Unit 75/BC Cushman loam

The Cushman loam map unit consists of sloping and moderately steep, well-drained soils that formed in residuum weathered from loamstone on uplands. Slopes range from 3 to 10 percent. The vegetation consists of various grasses, big sagebrush, and cactus.

Included in this unit are small areas of Parmleed clay loam. These inclusions comprise less than 5 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Unit Kl/AB Kishona loam

The Kishona loam map unit consists of nearly level, well-drained soils that formed in alluvium on alluvial fans and old terraces. Slopes range from 0 to 6 percent. The vegetation consists of various grasses, big sagebrush, and cactus.

Included in this unit are small areas of Zigweid loam and Shingle clay loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is moderate to high. The effective rooting depth is more than 60 inches.

These soils are used for range and wildlife habitat.

Unit PA Parmleed clay loam

The Parmleed clay loam map unit consists of nearly level to moderately steep, well-drained soils that formed in residuum weathered from loamstone and shale on the lower parts of rolling uplands. Slopes range from 6 to 10 percent. The vegetation consists of various grasses, cactus, and big sagebrush.

Included in this unit are small areas of Cushman clay loam and Renohill loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is slow, and the available water capacity is high. The effective rooting depth is 20 to 40 inches.

These soils are used primarily for range.

Unit Re/C Renohill loam

The Renohill loam map unit consists of nearly level to moderately steep, well-drained soils that formed in residuum weathered from shale on upland ridges and hillsides. Slopes range from 6 to 14 percent. The vegetation consists of big sagebrush and various grasses.

Included in this unit are small areas of Parmleed clay loam and Cushman clay loam. These inclusions comprise less than 15 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Unit SH Shingle clay loam

The Shingle clay loam map unit consists of gently sloping to steep, well-drained soils that formed in residuum derived from sandstone and loamstone on ridgetops and hillsides. Slopes range from 3 to 30 percent. The vegetation consists of various grasses and upland sedges.

Included in this unit are small areas of Cushman clay loam, Theedle loam, Kishona loam, and Zigweid loam. These inclusions comprise less than 20 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid to slow, and the available water capacity is low. The effective rooting depth is 6 to 18 inches.

These soils are used primarily for range.

Unit SH-G Shingle clay loam, gullied

The Shingle, gullied map unit consists of shallow, well drained, medium to fine-textured soils that formed in sediments of the Fort Union and Wasatch formations. They occur as actively eroding gullies in uplands which produce extremely steep and moderately steep topography. The vegetation consists of scattered grasses and shrubs.

Included in this unit are small areas of Theedle loam and Kishona loam. These inclusions comprise less than 20 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is slow to moderate, and available water capacity is low to moderate. The effective rooting depth is 10 to 20 inches on the shallow sites.

These soils are used for rangeland and wildlife habitat.

Unit TA Taluce sandy loam

The Taluce sandy loam map unit consists of moderately steep to steep, excessively-drained soils that formed in residuum weathered from sandstone on ridges. Slopes range from 15 to 40 percent. The vegetation consists of various grasses, upland edges, and cactus.

Included in this unit are small areas of Turnercrest loam, Bowbac sandy loam, Terro sandy loam and Shingle clay loam. These inclusions comprise less than 20 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 6 to 18 inches.

These soils are used for range and wildlife habitat.

Unit TE Terro sandy loam

The Terro sandy loam map unit consists of gently sloping to moderately steep, well-drained soils that formed in residuum derived primarily from sandstone. Slopes range from 6 to 15 percent. The vegetation consists of various grasses and upland sedges.

Included in this unit are small areas of Bowbac sandy loam, Turnercrest loam, and Taluce sandy loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is rapid, and the available water capacity is moderate to low. The effective rooting depth is 20 to 40 inches.

These soils are used primarily for range.

Unit TH Theedle loam

The Theedle loam map unit consists of sloping and moderately steep, well-drained soils that formed in residuum weathered from loamstone on uplands. Slopes range from 3 to 15 percent. The vegetation consists of various grasses, big sagebrush, and cactus.

Included in this unit are small areas of Shingle clay loam and Cushman clay loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Unit TUR Turnercrest loam

The Turnercrest loam map unit consists of gently sloping to moderately steep, well-drained soils that formed in eolian deposits and residuum derived primarily from sandstone. Slopes range from 3 to 10 percent. The vegetation consists of various grasses and upland sedges.

Included in this unit are small areas of Bowbac sandy loam, Taluce sandy loam, and Terro sandy loam. These inclusions comprise less than l0 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used primarily for range.

Unit Zn/B Zigweid loam

The Zigweid loam map unit consists of nearly level, well-drained soils that formed in alluvium derived from sandstone and loamstone on alluvial fans. Slopes range from 3 to 6 percent. The vegetation consists of various grasses.

Included in this unit are small areas of Kishona loam. These inclusions comprise less than 10 percent of the total acreage within this mapping unit.

Within individual profiles, permeability is moderately rapid, and the available water capacity is high. The effective rooting depth is more than 60 inches.

These soils are used for range and wildlife habitat.

5.0 1988 SOIL PROFILE DESCRIPTIONS

Bidman

Unit 354 AB Ulm-Bidman association, gently sloping

Unit 50/AB Bidman clay loam, 0 to 6 percent slopes

The Bidman series is a member of the fine, montmorillonitic, mesic family of Ustollic Paleargids. Typically, Sidman soils have very friable, medium granular, slightly acid E horizons resting abruptly on fine textured Bt horizons having prismatic and angular blocky structure, and fine to medium-textured Bk horizons in which secondary calcium carbonate has accumulated.

Description of Typical Profile

A typical example of the Bidman series was described and sampled for chemical analysis approximately 2150 feet east of the west section line of Section 25 and 4060 feet south of the north section line of Section 25, Township 44 North, Range 76 West (Sample Point No. 88-1).

E 0 to 3 inches. Light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure parting to very fine granular; soft, very friable; mildly alkaline (pH 7.4); abrupt, smooth boundary.

Bt 3 to 20 inches. Brown (IOYR 5/3) silty clay, dark brown (IOYR 4/3) moist; strong, medium, prismatic structure parting to strong, medium, angular blocky; hard, firm, very sticky and very plastic; mildly alkaline (pH 7.5); clear, wavy boundary.

Btk 20 to 36 inches. Light yellowish-brown (2.5Y 6/3) silty clay, light olive brown (2.5Y 5/3) moist; weak, coarse, prismatic structure parting to moderate, coarse, angular and subangular blocky; hard, very friable, sticky and plastic; mildly alkaline; gradual, wavy boundary.

Bk1 36 to 40 inches. Light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) moist; massive; hard, very friable; sticky and slightly plastic; mildly alkaline; gradual, wavy boundary.

Bk2 40 to 60 inches. Light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; massive; hard, very friable; mildly alkaline; slightly sticky and slightly plastic; mildly alkaline (pH 7.4).

Range of Characteristics on the Survey Area

Depth to calcareous material was greater than that normally found in the series.

Silt content of the 3 to 20 inch and 20 to 40 inch intervals is within or barely exceeding the upper range for the series and may not be typical throughout the survey area.

Reaction of the E horizon is slightly higher than that generally found in the series. Reaction of the Bk horizons is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Bidman series ranged from 45 inches to 60 inches, but average depth of material appearing suitable for the series was approximately 60 inches.

Bowbac

Unit BO Bowbac sandy loam, 6 to 15 percent slopes

The Bowbac series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Bowbac soils have very friable granular A horizons, moderately well developed Bt horizons with prismatic structure that when disturbed break to subangular blocks, and medium-textured Bk horizons in which secondary calcium carbonate has accumulated underlain with soft, calcareous sandstone.

Description of Typical Profile

A typical example of the Bowbac series was described and sampled for chemical analysis approximately 1850 feet east of the west section line of Section 13 and 140 feet north of the south section line of section 13, Township 44 North, Range 76 West (Sample Point No. 88-9).

A 0 to 3 inches. Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate, coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; medium acid; clear, smooth boundary.

AB 3 to 6 inches. Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate, coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; medium acid; clear, smooth boundary.

Bt 6 to 12 inches. Brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, coarse, prismatic structure parting to moderate medium and coarse subangular blocky; very hard, firm, sticky and plastic; neutral; clear, smooth boundary.

Btk 12 to 14 inches. Pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

Bk 14 to 36 inches. Pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline (ph 7.7); abrupt, wavy boundary.

Cr 36 inches plus. Soft, calcareous sandstone.

Range of Characteristics on the Survey Area

Depth to paralithic contact varied from 24 to 39 inches.

Reaction of the A horizon is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Bowbac series was approximately 36 inches.

Cushman

Unit 75/BC Cushman loam, 3 to 10 percent slopes

The Cushman series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Cushman soils have very friable granular A horizons, Bt horizons with prismatic structure that when disturbed break to angular and subangular blocks, and medium-textured, calcareous Bk horizons underlain with stratified calcareous shales and loamstone.

Description of Typical Profile

A typical example of the Cushman series was described and sampled for chemical analysis approximately 575 feet east of the west section line of Section 25 and 275 feet south of the north section line of Section 25, Township 44 North, Range 76 West (Sample Point No. 88-3).

A 0 to 3 inches. Light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure parting to moderate, medium, crumb; soft, very friable; slightly sticky and slightly plastic; neutral; clear, smooth boundary.

AB 3 to 6 inches. Brown (10YR 5/3) loam, dark brown (I0YR 4/3) moist; moderate, medium, granular structure; soft, friable, slightly sticky and slightly plastic; neutral; clear, smooth boundary.

Bt 6 to 22 inches. Brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, sticky and plastic; neutral; clear, smooth boundary.

Btk 22 to 26 inches. Pale brown (I0YR 6/3) clay loam, yellowish-brown (10YR 5/4) moist; moderate, medium, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

Bk1 26 to 28 inches. Pale brown (10YR 6/3) loam, yellowish-brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline; gradual, wavy boundary.

Bk2 28 to 36 inches. Pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline.

Cr 36 inches plus. Weathered, calcareous shales.

Range of Characteristics on the Survey Area

Depth to paralithic contact ranged from 24 inches to 39 inches.

Reaction of the B horizons is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Cushman series ranged from 24 to 39 inches, but average depth of material appearing suitable for topsoil was approximately 36 inches.

Forkwood (formerly Fort Collins)

Unit b45/AB Forkwood loam, 0 to 6 percent slopes

The Forkwood series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Forkwood soils have friable granular A horizons, Bt horizons with prismatic structure that when disturbed break to subangular blocks, and medium-textured Bk horizons in which secondary calcium carbonate has accumulated.

Description of Typical Profile

A typical example of the Forkwood series was described and sampled for chemical analysis approximately 2850 feet east of the west section line of Section 24 and 2350 feet north of the south section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-6).

A 0 to 5 inches. Light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable, non-sticky and nonplastic; slightly acid (pH 6.2); clear, smooth boundary.

Bt1 5 to 8 inches. Grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear, smooth boundary.

Bt2 8 to 26 inches. Brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; slightly acid; clear, smooth boundary.

Btk 26 to 30 inches. Pale-brown (I0YR 6/3) loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure; loose, friable, slightly sticky and nonplastic; mildly alkaline; clear, smooth boundary.

Bk1 30 to 48 inches. Pale-brown (I0YR 6/3) loam, brown (I0YR 5/3) moist; massive; loose, friable, nonsticky and nonplastic; mildly alkaline; gradual, wavy boundary.

Bk2 48 to 60 inches. Light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; loose, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.7).

Range of Characteristics on the Survey Area

Depth to paralithic ranged from 41 inches to greater than 60 inches.

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Average depth of material appearing suitable for the Forkwood series was greater than 60 inches.

Forkwood (formerly Fort Collins)

Unit b45/AB Forkwood loam, 0 to 6 percent slopes

The Forkwood series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Forkwood soils have friable granular A horizons, Bt horizons with prismatic structure that when disturbed break to subangular blocks, and medium-textured Bk horizons in which secondary calcium carbonate has accumulated.

Description of Typical Profile

A typical example of the Forkwood series was described and sampled for chemical analysis approximately 2050 feet west of the east section line of Section 24 and 2350 feet south of the north section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-13).

A 0 to 4 inches. Light brownish gray (10YR 6/2) loam, dark grayish (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable, non-sticky and nonplastic; medium acid; clear, smooth boundary.

AB 4 to 6 inches. Grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, friable, slightly sticky and nonplastic; medium acid; clear, smooth boundary.

Bt 6 to 18 inches. Grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; strong, medium prismatic structure parting to moderate, coarse subangular blocky; hard, firm, slightly sticky and slightly plastic; slightly acid; clear, smooth boundary.

BC 18 to 22 inches. Brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; slightly acid; clear, wavy boundary.

C1 22 to 30 inches. Pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; neutral; clear, smooth boundary.

C2 30 to 41 inches. Light brownish gray (10YR 6/2) sandy clay loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline.

Range of Characteristics on the Survey Area

Depth to paralithic ranged from 41 inches to greater than 60 inches.

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Average depth of material appearing suitable for the Forkwood series was greater than 60 inches.

Hiland (formerly Olney)

Unit a62/AB Hiland loam, 0 to 6 percent slopes

The Hiland series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Hiland soils have friable granular noncalcareous A horizons, moderately well developed Bt horizons with prismatic structure, medium to coarse-textured Bk horizons in which secondary calcium carbonate has accumulated, and medium to coarse-textured C horizons.

Description of Typical Profile

A typical example of the Hiland series was described and sampled for chemical analysis approximately 2125 feet east of the west section line of Section 24 and 75 feet north of the south section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-4).

A 0 to 6 inches. Grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.9); clear, smooth boundary.

Bt1 6 to 17 inches. Light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear, wavy boundary.

Bt2 17 to 19 inches. Light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate, medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear, wavy boundary.

Bk1 9 to 42 inches. Very pale brown (10YR 7/3) loam, pale brown (l0R 6/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; mildly alkaline (pH 7.7); gradual, wavy boundary.

Bk2 42 to 60 inches. Pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.7).

Range of Characteristics on the Survey Area

Within the Bt horizon at this location, the percent of clay was slightly over the range for a fine-loamy family. Overall, this sample was heavier than that normally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Hiland series was greater than 60 inches.

Hiland (formerly Olney)

Unit a62/AB Hiland loam, 0 to 6 percent slopes

The Hiland series is a member of the fine-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Hiland soils have friable granular noncalcareous A horizons, moderately well developed Bt horizons with prismatic structure, medium to coarse-textured Bk horizons in which secondary calcium carbonate has accumulated, and medium to coarse-textured C horizons.

Description of Typical Profile

A typical example of the Hiland series was described and sampled for chemical analysis approximately 2350 feet east of the west section line of Section 24 and 2350 feet south of the north section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-7).

A 0 to 7 inches. Grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable, nonsticky lan nonplastic; medium acid (pH 5.8); clear, smooth boundary.

Bt 7 to 24 inches. Light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; moderate, medium prismatic structure parting to moderate, medium subangular blocky; hard, firm, slightly sticky and slightly plastic; medium acid (pH 5.9); clear, wavy boundary.

C1 24 to 42 inches. Very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; neutral (pH 6.7); clear, wavy boundary.

C2 42 to 48 inches. Light brownish gray (10YR 6/2) loam, brown (I0YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear, wavy boundary.

Ck2 48 to 60 inches. Light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline.

Range of Characteristics on the Survey Area

Surface pH values were generally lower than that found within the series. In addition, the clay content of the Bt is on the lower end of the range for the series.

Depth of Material Appearing Suitable for Topsoil

Average depth of material appearing suitable for the Hiland series was greater than 60 inches.

Kishona (formerly Kim)

Unit KI/AB Kishona loam, 0 to 6 percent slopes

The Kishona series is a member of the fine-loamy, mixed, calcareous, mesic family of Ustic Torriorthents. Typically, Kishona soils have friable granular A horizons, weak subangular blocky Bk horizons, and fine to medium-textured, massive C horizons.

Description of Typical Profile

A typical example of the Kishona series was described and sampled for chemical analysis approximately 2400 feet west of the east section line of Section 24 and 1900 feet north of the south section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-12).

A 0 to 3 inches. Light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard, friable, non-sticky and nonplastic; medium acid (pH 5.6); clear, wavy boundary.

Bk 3 to 15 inches. Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; medium acid (pH 5.8); gradual, wavy boundary.

C1 15 to 30 inches. Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; medium acid (pH 6.0); clear, smooth boundary.

C2 30 to 48 inches. Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; firm, friable, nonsticky and nonplastic; slightly acid (pH 6.5); clear smooth boundary.

C2 48 to 60 inches. Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; firm, friable, nonsticky and nonplastic; neutral (pH 6.7).

Range of Characteristics on the Survey Area

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Kishona series was greater than 60 inches.

Parmleed (formerly Briggsdale)

Unit PA Parmleed clay loam, 6 to 10 percent slopes

The Parmleed series is a member of the fine, montmorillonitic, mesic family of Ustollic Paleargids. Typically, Parmleed soils have friable granular A or E horizons, Bt horizons with strong prismatic structure, and fine-textured Bk horizons in which secondary calcium carbonate has accumulated. They overlie interbedded shale at depths between 20 and 40 inches.

Description of Typical Profile

A typical example of the Parmleed series was described and sampled for chemical analysis approximately 1910 feet west of the east section line of Section 13 and 225 feet north of the south section line of Section 13, Township 44 North, Range 76 West (Sample Point No. 88-16).

E 0 to 3 inches. Light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure parting to fine granular; soft, very friable; medium acid (pH 6.0); abrupt, smooth boundary.

Bt 3 to 15 inches. Dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak, medium, pristhatic structure parting to moderate, medium, subangular blocky; hard, firm, sticky and plastic; slightly acid; clear, wavy boundary.

Btk 15 to 18 inches. Brown (10YR 5/3) clay loam, dark-brown (10YR 4/3) moist; moderate, coarse, subangular blocky; hard, friable; mildly alkaline; gradual, wavy boundary.

Bk1 18 to 21 inches. Brown (10YR 5/3) clay loam, dark-brown (10YR 4/3) moist; massive; hard, friable; mildly alkaline; gradual, wavy boundary.

Bk2 21 to 30 inches. Light brownish gray (I0YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable; mildly alkaline.

Range of Characteristics on the Survey Area

Depth to paralithic contact ranged from 26 to 37 inches.

Texture of the E horizon is heavier than that generally found in the series and may represent past erosion of this layer at this particular sample site.

Reaction of the E and Bt horizons is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Parmleed ranged from 26 inches to 37 inches, but average depth of material appearing suitable for the series was approximately 36 inches.

Parmleed (formerly Briggsdale)

Unit PA Parmleed clay loam, 6 to 10 percent slopes

The Parmleed series is a member of the fine, montmorillonitic, mesic family of Ustollic Paleargids. Typically, Parmleed soils have friable granular A or E horizons, Bt horizons with strong prismatic structure, and fine-textured Bk horizons in which secondary calcium carbonate has accumulated. They overlie interbedded shale at depths between 20 and 40 inches.

Description of Typical Profile

A typical example of the Parmleed series was described and sampled for chemical analysis approximately 2200 feet west of the east section line of Section 24 and 2000 feet north of the south section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-11).

A 0 to 4 inches. Light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium, granular structure; soft, friable; slightly sticky and slightly plastic; very strongly acid (pH 5.0); clear, smooth boundary.

Bt1 4 to 7 inches. Brown (10YR 5/3) clay loam, dark brown (l0YR 3/3) moist, weak, medium, prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; slightly acid; clear, smooth boundary.

Bt2 7 to 14 inches. Brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; strong, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm, sticky and plastic; slightly acid; clear, smooth boundary.

Bt3 14 to 17 inches. Pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak, medium, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear, smooth boundary.

Bk 17 to 30 inches. Pale brown (10YR 6/3) clay loam, yellowish-brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.5); gradual, wavy boundary.

Cr 30 inches plus. Weathered calcareous shale and loamstone and fragments.

Range of Characteristics on the Survey Area

Depth of paralithic contact ranged from 24 inches to 39 inches.

This sample point represents a Parmleed inclusion within an area mapped as Cushman.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Parmleed series ranged from 26 to 37 inches, but average depth of material appearing suitable for topsoil was approximately 36 inches.

Renohill

Unit Re/C Renohill clay, 6 to 14 percent slopes

The Renohill series is a member of the fine, montmorillonitic, mesic family of Ustollic Haplargids. Typically, Renohill soils have friable granular A horizons, Bt horizons with prismatic to blocky structure, and moderately fine to fine textured calcareous Bk horizons in which secondary calcium carbonate has accumulated. Sub-stratums of sedimentary bedrock generally occur greater than 40 inches.

Description of Typical Profile

A typical example of the Renohill series was described and sampled for chemical analysis approximately 590 feet west of the east section line of Section 13 and 1650 feet north of the south section line of Section 13, Township 44 North, Range 76 West (Sample Point No. 88-17).

A 0 to 3 inches. Light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; strong, fine, granular structure; soft, very friable, sticky and plastic; slightly acid (pH 6.2); clear, smooth boundary.

Bt 3 to 11 inches. Grayish-brown (2.5Y 5/2) clay (field estimate texture), dark grayish-brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium angular blocky; hard, friable, very sticky and very plastic; neutral (pH 7.2); gradual, wavy boundary.

Btk 11 to 15 inches. Light yellowish-brown (2.5Y 6/3) clay loam (field estimate texture), light olive-brown (2.5Y 5/3) moist; weak, coarse, subangular blocky structure; hard, firm, plastic; mildly alkaline; gradual, smooth boundary.

Bk 15 to 23 inches. Light yellowish-brown (2.5Y 6/3) clay loam (field estimate texture), light olive-brown (2.5Y 5/3) moist; massive; very hard, firm; mildly alkaline.

C 23 to 30 inches. Light yellowish-brown (2.5Y 6/3) clay loam (field estimate texture), light olive-brown (2.5Y 5/3) moist; some shale fragments; massive; slightly hard, friable, slightly sticky; moderately alkaline.

Cr 30 inches plus. Soft, calcareous shale.

Range of Characteristics on the Survey Area

Depth to bedrock ranged from 24 to 38 inches.

Reaction of the A and B horizons is lower than that generally found in the series. Texture of the A horizon is heavier than that generally found in the series but may be a result of minor surface erosion at the sample site.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Renohill series was approximately 30 inches.

Samday* (formerly Samsil)

Unit SM Samday silty clay, 3 to 30 percent slopes

The Samday series is a member of the clayey, montmorillonitic, calcareous, mesic, shallow family of Ustic Torriorthents. Typically, Samday soils have friable platy A horizons with fine textured transitional layers that grade to unweathered shale at shallow depths.

Description of Typical Profile

A typical example of the Samday series was described and sampled for chemical analysis approximately 410 feet west of the east section line of Section 13 and 1470 feet north of the south section line of Section 13, Township 44 North, Range 76 West (Sample Point No. 88-15).

A 0 to 3 inches. Grayish-brown (2.5Y 5/2) silty clay, dark grayish-brown (2.5Y 4/2) moist; moderate, medium, platy structure parting to weak, fine granular structure; soft, very friable, slightly sticky and slightly plastic; slightly acid (pH 6.4); clear, smooth boundary.

Ck 3 to 13 inches. Light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; massive structure; hard, firm; neutral (pH 7.0); gradual, wavy boundary.

Cr 13 inches plus. Yellowish-gray, calcareous shale.

* Shingle Unit SH

Range of Characteristics on the Survey Area

Depth to bedrock ranged from 5 to 18 inches.

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Samday series ranged from 5 to 18 inches. Average depth of material appearing suitable for topsoil was approximately 12 inches.

Taluce (formerly Tassel)

Unit TA Taluce sandy loam, 15 to 40 percent slopes

The Taluce series is a member of the loamy, mixed, calcareous, mesic, shallow family of Ustic Torriorthents. Typically, Taluce soils have very friable, fine granular A horizons and calcareous C horizons underlain by sandstone bedrock.

Description of Typical Profile

A typical example of the Taluce series was described and sampled for chemical analysis approximately 2280 feet east of the west section line of Section 24 and 1125 feet south of the north section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-14).

A 0 to 3 inches. Yellowish-brown (10YR 5/4) sandy loam, dark yellowish-brown (10YR 4/4) moist; moderate, medium, granular structure; loose, very friable; nonsticky and nonplastic; neutral (pH 7.3); clear, smooth boundary.

C 3 to 18 inches. Light yellowish-brown (10YR 6/4) sandy loam, yellowish-brown (10YR 5/4) moist; moderate, medium, granular structure; soft, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.6).

Cr 18 inches plus. Soft, calcareous sandstone.

Range of Characteristics on the Survey Area

Depth of bedrock varied from 6 to 18 inches.

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Taluce series ranged from 6 to 18 inches. Average depth of material appearing suitable for topsoil was approximately 15 inches.

Terro (formerly Terry)

Unit TE Terro sandy loam, 6 to 15 percent slopes

The Terro series is a member of the coarse-loamy, mixed, mesic family of Ustollic Haplargids. Typically, Terro soils have friable granular A horizons, Bt horizons with weak, medium subangular blocky structure, and medium-textured Bk horizons in which secondary calcium carbonate has accumulated.

Description of Typical Profile

A typical example of the Terro series was described and sampled for chemical analysis approximately 2260 feet east of the west section line of Section 13 and 250 feet north of the south section line of Section 13, Township 44 North, Range 76 West (Sample Point No. 88-10).

A	0 to 3 inches. Light brownish-gray (10YR 6/2) sandy loam, dark grayish-brown (10YR 4/2) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; neutral (pH 6.6); clear, smooth boundary.

Bt	3 to 15 inches. Pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak, medium, prismatic structure parting to weak, medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; neutral (pH 6.6); clear, smooth boundary.

Bk	15 to 38 inches. Pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.5); gradual, wavy boundary.

Cr	38 inches plus. Soft, calcareous sandstone.

Range of Characteristics on the Survey Area

Depth to paralithic contact varied from 24 to 39 inches.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Terro series was approximately 36 inches.

Turnercrest (formerly Nelson)

Unit TUR Turnercrest loam, 3 to 10 percent slopes

The Turnercrest series is a member of the coarse-loamy, mixed, calcareous, mesic family of Ustic Torriorthents. Typically, Turnercrest soils have friable granular A horizons and medium to coarse-textured, calcareous C horizons.

Description of Typical Profile

A typical example of the Turnercrest series was described and sampled for chemical analysis approximately 2410 feet east of the west section line of Section 13 and 25 feet north of the south section line of Section 13, Township 44 North, Range 76 West (Sample Point No. 88-8).

A	0 to 4 inches. Brown (l0YR 5/3) loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 7.3); clear, smooth boundary.

Bw 4 to 10 inches. Brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky; soft, friable, slightly sticky and slightly plastic; mildly alkaline; gradual, smooth boundary.

Cl 10 to 24 inches. Light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear, wavy boundary.

C2 24 to 39 inches. Light gray (2.5Y 7/2) sandy loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; mildly alkaline (pH 7.5); clear, wavy boundary.

Cr 39 inches plus. Soft, calcareous sandstone.

Range of Characteristics on the Survey Area

Depth to paralithic ranged from 30 to 39 inches.

Reaction of the A horizon is slightly lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Turnercrest series was approximately 36 inches.

ULM*

Unit UL Ulm silty clay, 3 to 6 percent slopes

The Ulm series is a member of the fine, montmorillonitic, mesic family of Ustollic Haplargids. Typically, Ulm soils have friable granular A horizons, well developed Bt horizons, and medium-textured, calcareous Bk horizons.

Description of Typical Profile

A typical example of the Ulm series was described and sampled for chemical analysis approximately 1350 feet east of the west section line of Section 25 and 1350 feet south of the north section line of Section 25, Township 44 North, Range 76 West (Sample Point No. 8 8-2).

A 0 to 3 inches. Light brownish-gray (10YR 6/2) silty clay, dark grayish-brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable, slightly sticky and slightly plastic; neutral; clear, smooth boundary.

Bw 3 to 9 inches. Light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate, fine subangular blocky parting to moderate, medium granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear, smooth boundary.

Bt 9 to 24 inches. Brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; strong, medium prismatic structure parting to strong, fine angular and subangular blocky; very hard, friable, sticky and slightly plastic; mildly alkaline; gradual, smooth boundary.

Btk 24 to 30 inches. Light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) moist; moderate, medium subangular blocky; very hard, friable, sticky and slightly plastic; mildly alkaline; gradual, smooth boundary.

Bkl 30 to 36 inches. Light yellowish-brown (2.5Y 6/3) silty clay, light olive-brown (2.5Y 5/3) moist; massive; hard, friable, sticky and slightly plastic; mildly alkaline; gradual, wavy boundary.

Cl 36 to 48 inches. Light yellowish-brown (2.5Y 6/4) silty clay, light olive-brown (2.5Y 5/4) moist; massive; hard, friable, sticky and slightly plastic; mildly alkaline; gradual, wavy boundary.

C2 48 to 60 inches. Light yellowish-brown (2.5Y 6/4) silty clay, light olive-brown (2.5Y 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline (ph 7.4).

Range of Characteristics on the Survey Area

Analyzed textures varied significantly from field textures. It is assumed that total sample dispersion may not have been achieved and the silt content of the resultant analysis may be too high.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Ulm series was greater than 60 inches.

Ziegweid

Unit Zg/B Zigweid loam, 3 to 6 percent slopes

The Zigweid series is a member of the fine-loamy, mixed, mesic family of Ustollic Camborthids. Typically, Zigweid soils have friable granular A horizons, weakly developed Bw horizons, and medium-textured, calcareous Bk horizons.

Description of Typical Profile

A typical example of the Zigweid series was described and sampled for chemical analysis approximately 700 feet east of the west section line of Section 24 and 800 feet south of the north section line of Section 24, Township 44 North, Range 76 West (Sample Point No. 88-5).

A 0 to 6 inches. Light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; strong, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; neutral (pH 7.3); clear, smooth boundary.

Bw 6 to I 1 inches. Light olive-brown (2.5Y 5/3) silty clay loam, olive-brown (2.5Y 4/3) moist; weak, medium, prismatic structure paring to moderate, medium, subangular blocky; hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.5); gradual, smooth boundary.

Bk1 11 to 30 inches. Light brownish-gray (2.5Y. 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.5); gradual, wavy boundary.

Bk1 30 to 48 inches. Light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.6); gradual, wavy boundary.

Bk2 48 to 60 inches. Light brownish-gray (2.5y 6/2) silty clay loam, grayish-brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4).

Range of Characteristics on the Survey Area

Depth to calcareous material was greater than that normally found in the series.

Reaction throughout the profile is lower than that generally found in the series.

Depth of Material Appearing Suitable for Topsoil

Depth of material appearing suitable on the survey area for the Zigweld series was greater than 60 inches.

6.0 1988 SOIL ANALYTICAL RESULTS

Bidman Clay Loam (Sample Point 88-1)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	32	41	27	CL	<2
3-20	12	45	43	Sic	<2
20-40	8	47	45	Sic	<2
40-60	32	39	29	CL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-3	0.3	0.01	3.75	34.0	2.3
3-20	0.4	<0.01	4.40	43.1	3.8
20-40	1.0	0.01	4.54	50.7	5.6
40-60	0.6	0.19	3.05	30.6	3.6

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	7.4	0.92	7.0	1.89	0.37	0.18
3-20	7.5	0.75	3.70	2.08	0.76	0.45
20-40	7.6	0.97	3.55	2.97	3.39	1.88
40-60	7.4	3.90	27.0	21.3	10.2	2.08

Bowbac Sandy Loam (Sample Point 88-9)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-6	60	23	17	SL	<2
6-14	54	25	21	SCL	<2
14-36	50	27	23	SCL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-6	0.3	<0.01	3.07	40.0	0.5
6-14	0.1	<0.01	3.17	40.3	2.1
14-36	<0.1	<0.01	2.89	40.5	6.2

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-6	6.0	0.63	3.69	1.12	0.15	0.10
6-14	7.0	0.76	5.22	1.19	0.16	0.09
14-36	7.7	0.55	1.95	1.61	0.83	0.62

Cushman Loam (Sample Point 88-3)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-6	38	43	19	L	<2
6-26	38	34	28	CL	<2
26-36	48	30	22	L	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-6	<0.1	<0.01	2.79	26.8	0.8
6-26	<0.1	<0.01	3.28	34.6	1.1
26-36	0.2	<0.01	2.76	39.5	7.5

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-6	7.1	0.66	3.78	1.68	0.28	0.17
6-26	7.1	0.80	4.31	2.35	0.46	0.25
26-36	7.6	0.74	3.13	2.68	0.87	0.51

Forkwood Loam (formerly Fort Collins) (Sample Point 88-6)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-5	50	34	16	L	<2
5-26	44	31	25	L	<2
26-48	40	37	23	L	<2
48-60	58	27	15	SL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-5	0.1	<0.01	2.40	21.8	<0.1
5-26	0.1	<0.01	3.08	39.8	<0.1
26-48	0.1	<0.01	3.54	40.0	5.2
48-60	0.3	<0.01	2.33	33.3	2.2

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-5	6.2	0.44	2.15	1.06	0.18	0.14
5-26	6.5	0.54	2.51	1.24	0.22	0.16
26-48	7.6	0.53	2.37	1.60	0.82	0.58
48-60	7.7	0.82	2.53	2.19	2.77	1.80

Hiland Loam (formerly Olney) (Sample Point 88-4)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-6	42	28	20	L	<2
6-19	22	42	36	CL	<2
19-42	40	36	24	L	<2
42-60	46	32	22	L	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-6	0.1	<0.01	2.99	27.9	0.9
6-19	0.1	0.01	3.89	41.8	1.0
19-42	0.2	<0.01	3.04	33.1	6.2
42-60	0.4	0.02	2.62	29.0	4.3

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-6	6.9	0.88	4.85	2.29	0.17	0.09
6-19	6.9	0.87	4.58	2.54	0.51	0.27
19-42	7.7	0.64	2.00	1.86	1.36	0.98
42-60	7.7	1.20	3.21	3.63	4.11	2.22

Hiland Loam (formerly Olney) (Sample Point 88-7)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-7	48	37	15	L	<2
7-24	48	32	20	L	<2
24-42	42	36	22	L	<2
42-60	48	30	22	L	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-7	0.3	<0.01	4.37	41.7	<0.1
7-24	0.2	0.01	2.74	33.9	<0.1
24-42	0.3	<0.01	2.51	39.7	<0.1
42-60	0.2	<0.01	2.70	39.9	1.0

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-7	5.8	0.50	2.80	1.18	0.14	0.10
7-24	5.9	0.48	2.70	1.05	0.20	0.15
24-42	6.7	0.58	2.76	1.10	0.25	0.18
42-60	7.4	0.67	3.44	1.46	0.30	0.19

Forkwood Loam (formerly Fort Collins) (Sample Point 88-13)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-6	50	32	18	L	<2
6-22	48	26	26	SCL	<2
22-41	50	26	24	SCL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-6	0.3	<0.01	2.18	32.5	0.2
6-22	0.1	<0.01	3.41	39.0	0.3
22-41	0.1	<0.01	3.00	36.6	1.7

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-6	5.8	0.68	3.28	1.58	0.18	0.12
6-22	6.2	0.38	1.98	0.94	0.17	0.14
22-41	7.0	1.80	9.26	4.77	0.43	0.16

Kishona Loam (formerly Kim) (Sample Point 88-12)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	36	39	25	L	<2
3-15	38	37	25	L	<2
15-30	42	35	23	L	<2
30-48	48	31	21	L	<2
48-60	48	29	23	L	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-3	0.3	0.02	6.33	61.9	0.5
3-15	0.2	<0.01	3.51	42.4	0.9
15-30	0.3	<0.01	2.89	36.7	0.3
30-48	0.3	<0.01	2.62	35.7	0.3
48-60	0.3	<0.01	2.51	34.2	03

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	5.6	1.10	7.00	2.73	0.28	0.13
3-15	5.8	0.50	2.82	0.97	0.11	0.08
15-30	6.0	0.28	1.66	0.47	0.11	0.11
30-48	6.5	0.31	1.73	0.51	0.18	0.17
48-60	6.7	0.40	2.42	0.66	0.14	0.11

Turnercrest Loam (formerly Nelson) (Sample Point 88-8)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-4	50	32	18	L	<2
4-24	56	23	21	L	<2
24-39	60	21	19	SL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-4	0.2	<0.01	2.54	36.0	0.5
4-24	0.1	<0.01	2.27	42.5	1.1
24-39	0.1	0.02	2.13	34.7	1.1

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-4	7.3	0.63	3.69	0.99	0.17	0.11
4-24	7.5	0.53	3.13	0.98	0.52	0.36
24-39	7.5	1.30	8.18	2.67	1.55	0.67

Parmleed Loam (formerly Briggsdale) (Sample Point 88-11)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-4	36	39	25	L	<2
4-17	20	37	43	C	<2
17-30	36	33	31	CL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-4	0.2	<0.01	4.15	44.7	0.5
4-17	0.2	<0.01	4.32	59.8	0.8
17-30	0.2	<0.01	3.51	48.3	3.7

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-4	5.0	0.93	4.25	2.23	0.20	0.11
4-17	6.3	0.83	3.77	2.12	0.46	0.27
17-30	7.5	0.73	3.45	2.14	0.55	0.33

Parmleed Clay Loam (formerly Briggsdale) (Sample Point 88-16)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	40	30	30	CL	<2
3-18	30	32	38	CL	<2
18-30	38	32	30	CL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-3	0.3	<0.01	3.94	45.5	0.3
3-18	0.4	<0.01	4.16	51.4	0.3
18-30	0.3	0.02	3.18	44.3	1.1

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0.3	6.0	0.56	2.60	1.34	0.20	0.14
3-18	6.3	0.37	1.47	0.76	0.29	0.27
18-30	7.4	0.60	2.63	1.46	1.13	0.79

Renohill Clay (Sample Point 88-17)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	20	34	46	C	<2
3-15	NS	NS	NS	NS	<2
15-30	NS	NS	NS	NS	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-3	0.4	<0.01	5.12	56.2	0.8
3-15	NS	NS	NS	60.4	NS
15-30	NS	NS	NS	74.9	NS

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	6.2	0.48	1.83	1.46	0.65	0.51
3-15	7.2	0.48	1.76	1.42	2.16	1.72
15-30	7.5	1.50	4.06	4.27	8.15	3.99

NS = Insufficient Sample

Samday Silty Clay (formerly Samsil) (Sample Point 88-15)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	18	42	40	SiC	<2
3-13	16	42	42	SiC	<2
Depth (inches)	**B (ppm)**	**Se (ppm)**	**Organic Carbon (%)**	**Satur. (%)**	**Lime (ppm)**
0-3	0.3	<0.01	4.74	59.9	0.6
3-13	0.3	<0.01	4.74	51.3	1.0

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0.3	6.4	0.82	3.04	2.72	1.06	0.62
3-13	7.0	0.70	2.09	1.59	2.19	1.61

Taluce Sandy Loam (formerly Tassel) (Sample Point 88-14)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	72	16	12	SL	<2
3-18	76	12	12	SL	<2
Depth (inches)	**B (ppm)**	**Se (ppm)**	**Organic Carbon (%)**	**Satur. (%)**	**Lime (ppm)**
0-3	0.3	<0.01	3.14	35.5	1.0
3-18	<0.1	<0.01	2.29	32.4	2.4

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	7.3	0.78	5.64	0.61	0.16	0.09
3-18	7.6	0.45	3.12	0.35	0.11	0.08

Terro Sandy Loam (formerly Terry) (Sample Point 88-10)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-3	62	23	15	SL	<2
3-15	62	21	17	SL	<2
15-38	50	29	21	L	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-3	<0.1	<0.01	2.61	35.8	0.5
3-15	0.2	<0.01	2.52	35.8	0.6
15-38	0.1	<0.01	2.96	40.2	3.8

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	6.6	0.49	3.00	0.99	0.15	0.11
3-15	6.6	0.45	3.01	0.87	0.13	0.09
15-38	7.5	0.55	3.51	0.93	0.16	0.11

Ulm Silty Clay (Sample Point 88-2)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-9	10	49	41	SiC	<2
9-30	6	49	45	SiC	<2
30-48	4	51	45	SiC	<2
48-60	1	56	43	SiC	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-9	0.2	<0.01	4.60	46.0	1.1
9-30	0.3	<0.01	4.45	47.5	4.5
30-48	0.9	0.04	4.45	49.7	5.9
48-60	0.4	0.29	4.52	46.0	4.7

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-9	6.9	0.74	4.10	2.13	0.59	0.34
9-30	7.5	0.72	3.26	2.04	1.11	0.68
30-48	7.6	1.50	5.53	4.75	5.05	2.23
48-60	7.4	3.80	26.8	19.0	8.9	1.86

Zigweld Loam (Sample Point 88-5)

Depth (inches)	Mechanical Analysis				
	Sand	Silt	Clay	Texture	Coarse Fragments (%)
0-6	30	44	26	L	<2
6-11	20	52	28	SiCL	<2
11-30	26	48	26	L	<2
30-48	32	42	26	L	<2
48-60	14	58	28	SiCL	<2
Depth (inches)	B (ppm)	Se (ppm)	Organic Carbon (%)	Satur. (%)	Lime (ppm)
0-6	0.2	<0.01	3.48	35.0	4.8
6-11	0.2	<0.01	3.33	35.3	5.8
11-30	0.2	<0.01	3.24	33.6	6.1
30-48	<0.1	0.01	3.04	32.1	5.5
48-60	0.1	0.02	3.37	35.0	5.0

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-6	7.3	0.65	4.28	0.96	0.19	0.12
6-11	7.5	0.55	3.67	0.73	0.38	0.26
11-30	7.5	0.64	3.73	0.78	0.41	0.27
30-48	7.6	0.77	4.92	1.44	0.24	0.13
48-60	7.4	2.80	27.3	8.96	0.69	0.16

7.0 1978-79 MAPPING UNIT DESCRIPTIONS

1A - Haverson loam, 0 to 3 percent slopes*

The Haverson soil is a deep, well-drained loamy soil. It developed in highly stratified, calcareous recent alluvium derived from mixed sources. It occurs on floodplains and low terraces of stream and drainages at elevations of 3,800 to 5,000 feet. The average annual rainfall ranges from 10 to 14 inches. Average annual air temperature is about 44°F., and the average frost-free season is about 140 days. Small areas of Glenburg fine sand were included in mapping.

In a typical profile the surface layer is light brownish gray loam about 6 inches thick. The subsoil and substratum are light brownish gray loam stratified with thin lenses of clay loam and fine sandy loam about 54 inches thick.

Permeability is moderate. Available water capacity is moderate to high. Effective rooting depth is 60 inches or more. Surface runoff is slow to medium and erosion hazard is moderate.

This soil is used for rangeland and wildlife habitat.

Capability unity IVe2, dryland; Lowland range site (10 to 14 inch precipitation zone).

*1A - Haverdad loam, 0 to 3 percent slopes

b45 - Fort Collins loam. 0 to 6 percent slopes*

The Fort Collins soil is a deep, well-drained loamy soil which occurs throughout the county. It developed in thick, calcareous alluvial fan and valley-filling fan sediments derived from sedimentary bedrock and is on uplands and elevations of 3,800 to 5,000 feet. The average annual rainfall ranges from 10 to 14 inches.

Average annual air temperature is about 44°F., and the average frost-free season is about 140 days. Although the slopes range from 0 to 6 percent, they are mostly about 3 percent. Small areas of Stoneham loam were included in mapping.

In a typical profile the surface layer is light brownish gray loam about 4 inches thick. The subsoil is light brownish gray light clay loam about 11 inches thick. The substratum is light yellowish brown light clay loam about 45 inches thick and is underlain with shale bedrock at depths of 40 to 60+ inches.

Permeability is moderate. Available water capacity is moderate to high. Effective rooting depth is 40 to 60+ inches. Surface runoff is slow to medium, and the erosion hazard is moderate.

This soil is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unit IVe2, dryland; Loamy range site (10 to 14 inch precipitation zone).

*b45/AB – Forkwood loam, 0 to 6 percent slopes

50/AB – Bidman loam, 0 to 6 percent slopes

The Bidman soil is a deep, well-drained, loamy soil which occurs throughout the county. It developed in thick, calcareous, alluvial fan and valley-filling fan sediments derived from sedimentary bedrock and is on uplands at elevations of 3,800 to 5,000 feet. The average rainfall ranges from 10 to 14 inches, the average annual air temperature is about 44°F., and the average frost-free season is about 140 days. Although the slopes range from 0 to 6 percent, they are mostly about 3 percent. Small areas of Ulm loam were included in mapping.

In a typical profile the surface layer is light gray loam about 4 inches thick. The subsoil is brown clay about 15 inches thick. The lower portion of the subsoil is light olive brown clay. The substratum is calcareous, grayish brown clay to 60 inches in depth.

Permeability is slow. The available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow to medium and erosion hazards is moderate.

This soil is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unity IVe2, dryland; Loamy range site (10 to 14 inch precipitation zone).

a62/AB - Olney fine sandy loam, 0 to 6 percent slopes*

The Olney soil is a deep, well-drained sandy soil which occurs throughout the county. It developed in thick, moderately coarse-textured, calcareous parent materials on nearly level to gently annual rainfall ranges from 10 to 14 inches, and the average annual air temperature is about 44°F. The average frost-free season is about 140 days. Small areas of Vona fine sandy loam were included in mapping. Locally, the parent materials may have been reworked.

In a typical profile the surface layer is light gray fine sandy loam about 4 inches thick. The subsoil is pale brown sandy clay loam about 23 inches thick. The substratum is light yellowish brown sandy loam about 21 inches thick.

Permeability is rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow and the erosion hazard is severe.

This soil is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unit IVe5, dryland; Sandy range site (10 to 14 inch precipitation zone).

*a62/AB – Hiland loam, 0 to 6 percent slopes

a62/C - Olney fine sandy loam, 6 to 10 percent slopes*

The Olney soil is a deep, well-drained sandy soil which occurs throughout the county. It developed in thick, moderately coarse-textured, calcareous parent materials derived from sandier strata of the Wasatch beds on side slopes at elevations of 3,800 to 5,000 feet. The average annual rainfall ranges from 10 to 14 inches. The average annual air temperature is about 44°F. The average frost-free season is about 140 days. Small areas of Pugsley sandy loam were included in mapping. Pugsley soils usually occur on the upper portions of the side slopes. It has sandy clay loam subsoils and is underlain with bedrock at depths of 20 to 40 inches.

In a typical profile the surface layer is light gray fine sandy loam about 4 inches thick. The subsoil is pale brown sandy clay loam about 23 inches thick. The substratum is light yellowish brown sandy loam about 21 inches thick.

Permeability is rapid. The available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow to medium, and erosion hazard is severe.

This soil is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unit VIe5, dryland; Sandy range site (10 to 14 inch precipitation zone).

*A62/C – Hiland fine sandy loam, 6 to 10 percent slopes

75/B - Cushman very fine sandy loam, 3 to 6 percent slopes*

The Cushman soil is a moderately deep, well-drained loamy soil in the southern portion of Campbell County. It developed from calcareous sediments derived from sedimentary bedrock and is on gently sloping upland basins and large valley-filling fans at elevations between 3,800 and 5,000 feet. The average annual rainfall ranges from 10 to 14 inches. The average annual air temperature is about 44°F., and the average frost-free season is about 144 days. Small areas of Fort Collins loam were included in mapping.

In a typical profile the surface layer is light brownish gray very fine sandy loam, about 4 inches thick. The subsoil is brown very fine sandy clay loam 17 inches thick. The substratum is grayish brown very fine sandy clay loam about 6 inches thick and is underlain with soft, very fine-grained sandstone and loamstone bedrock at a depth of 23 inches.

The Cushman soil has a moderate permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is moderate. Surface runoff is medium and the hazard of erosion is moderate.

This soil is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unit IVe2, dryland; Loamy range site (I0 to 14 inch precipitation zone).

*75/BC Cushman loam, 3 to 10 percent slopes

15I/DE – Shingle-Rock outcrop complex, 10 to 60 percent slopes

This association consists of moderately steep to very steep soils and Rock outcrop on side slopes and ridge tops at elevations between 3,800 and 5,000 feet. This complex is about 60 percent Shingle clay loam, 10 to 60 percent slopes, and about 40 percent Rock outcrop, 10 to 60 percent slopes. The Shingle soil doesn't occupy any particular position in the landscape but will occur on the ridge tops and lower portions of the side slopes. The side slopes are usually dissected by numerous deep gullies which drain into nearby intermittent streams.

Included with this complex are areas of Thedalund and Kim soils. The Thedalund soil usually occurs in association with the Shingle soils. It has loam substrata which are underlain with shale bedrock at a depth of 20 to 40 inches. The Kim soils usually occur on the lower portions of the side slopes. It has clay loam substrata and is underlain with shale bedrock at depths of 40 to 60+ inches. These inclusions make up about 20 percent of the total acreage.

The Shingle soil is a shallow, well-drained soil. It formed in calcareous, moderately alkaline sediments derived from moderately fine-textured sedimentary shales. The average annual precipitation ranges from 10 to 14 inches, and the average annual air temperature is about 44°F.

In a representative Shingle profile the surface layer is light brown gray clay loam about 4 inches thick. The substratum is light yellowish brown clay loam about 11 inches thick which is underlain with soft, calcareous shale at a depth of 15 inches.

The Shingle soil has a moderate permeability. Effective rooting depth ranges from 10 to 20 inches. Available water capacity is low. Surface runoff is rapid, and the hazard of erosion is severe.

The Rock outcrop consists of multi-colored, calcareous to noncalcareous, medium to fine-textured, soft to hard shales and siltstones. It usually occurs on side slopes where geologic erosion has prevented soils from developing.

This complex is used for rangeland and wildlife habitat.

Shingle soils: Capability unit VIIe14, dryland: Shallow Loamy range site (10 to 14 inch precipitation zone).

Rock outcrop: Capability unit VIIIe83; Range site not assigned.

347/D - Shingle-Rock outcrop-Samsil complex, 10 to 30 percent slopes*

This complex consists of sloping to moderately steep soils on side slopes and ridge crests in the uplands at elevations between 3800 and 5000 feet. This complex is about 50 percent Shingle clay loam, 10 to 30 percent slopes, about 30 percent Rock outcrop, 10 to 30 percent slopes, and about 20 percent Samsil clay, 10 to 30 percent slopes. Neither soil nor Rock outcrop occupies any particular position in the landscape in relation to each other but is dependent upon the type of parent material present. The side slopes in this unit may be dissected by numerous small drainages in some areas. The Shingle soil has clay loam subsoils which are underlain with soft, calcareous shale bedrock at a depth of 10 to 20 inches. The Samsil soil has clay substrata which is underlain with soft, calcareous shale bedrock at depths of 10 to 20 inches.

Included with this complex in mapping are areas of Thedalund loam and Kim clay loam. The Thedalund soils have loam substrata which are underlain with soft, calcareous bedrock at depths of 20 to 40 inches and usually occur on the upper portions of the side slopes. The Kim soils have clay loam soils and usually occur on the lower portions of the side slopes. These inclusions make up about 15 percent of the total acreage.

The Shingle soil is a shallow, well-drained soil. It formed in calcareous, moderately alkaline sediments derived from moderately fine-textured sedimentary shales. The average annual precipitation range from 10 to 14 inches, and the average annual air temperature is about 44°F.

In a representative Shingle profile the surface layer is light brownish gray clay loam about 4 inches thick. The substratum is light yellowish brown clay loam about 11 inches thick which is underlain with soft, calcareous shale at a depth of 15 inches.

The Shingle soil has a moderate permeability. Effective rooting depth ranges from 10 to 20 inches. Available water capacity is low. Surface runoff is rapid and the hazard of erosion is severe.

The Rock outcrop consists of multi-colored, calcareous to noncalcareous, medium to fine-textured, soft to hard shales and siltstones.

The Samsil soil is a shallow, well-drained soil. It formed in fine-textured, calcareous, moderately alkaline materials derived from sedimentary bedrock. The average annual precipitation is about .10 to 14 inches, and the average annual air temperature is about 44°F.

In a representative Samsil profile the surface layer is light brownish gray clay about 5 inches thick. The substratum is light yellowish brown clay about 9 inches thick which is underlain with calcareous clayey shale at a depth of 14 inches.

The Samsil soil has a slow permeability. Effective rooting depth ranges from 10 to 20 inches. Available water capacity is low to moderate. Surface runoff is rapid and the hazard of erosion is severe.

This complex is used for rangeland and wildlife habitat.

Shingle soils: Capability unit VIle14, dryland; Shallow Loamy range site (10 to 14 inch precipitation zone).

Rock outcrop: Capability unit VIIIe83; Range site not assigned.

Samsil soils: Capability unit VII314, dryland; Shallow Clayey range site (10 to 14 inch precipitation zone).

*347/D - Shingle-Rock outcrop-Samday complex, 10 to 30 percent slopes.

<u>354/AB – Ulm-Bidman association, gently sloping</u>

This association consists of nearly level to gently sloping soils on valley-filling fans and side slopes at elevations between 3,800 and 5,000 feet. This association is about 60 percent Ulm loam, 0 to 6 percent slopes, and about 40 percent Bidman loam, 0 to 6 percent slopes. Neither soil occupies any particular position in the landscape. The Ulm soil has heavy clay loam subsoils and is underlain with bedrock at depths of 40 to 60+ inches. The Bidman soil has clay subsoils and is underlain with bedrock at depths of 40 to 60+ inches.

Included with this association in mapping are areas of Briggsdale and Absted soils. The Briggsdale soil usually occurs on the upper portions of valley-filling fans and side slopes. It has clay subsoils and is underlain with bedrock at depths of 20 to 40 inches. The Absted soil usually occurs on the lower portions of the valley-filling fans and side slopes. It has clay subsoils and is underlain with bedrock at depths of 40 to 60+ inches. These inclusions make up about 10 percent of the total acreage.

The Ulm soil is a deep, well-drained soil. It formed in calcareous, moderately alkaline materials derived from sedimentary shales. The average annual precipitation ranges from 10 to 14 inches, and the average annual air temperature is about 44°F

In a representative Ulm profile, the surface layer is light brownish gray loam about 5 inches thick. The subsoil is brown heavy clay loam about 17 inches thick. The substratum is light yellowish brown clay loam about 38 inches thick.

The Ulm soil has a slow permeability. Effective rooting depth ranges from 20 to 40 inches. Available water capacity is moderate. Surface runoff is moderate, and the hazard of erosion is moderate.

The Bidman soil is a deep, well-drained soil. It formed in calcareous, moderately alkaline materials derived from sedimentary shales. The average annual precipitation ranges from 10 to 14 inches, and the average annual air temperature is about 44°F.

In a representative Bidman profile the surface layer is light gray loam about 4 inches thick. The subsoil is brown clay about 15 inches thick. The lower portion of the subsoil is light olive brown clay. The substratum is calcareous grayish brown clay to 60 inches in depth.

The Bidman soil has a slow permeability. Effective rooting depth ranges from 40 to 60+ inches. Available water capacity is moderate. Surface runoff is moderate and the hazard of erosion is moderate.

This association is used for rangeland, wildlife habitat, and dryland cultivation.

Capability unit IVe2, dryland; Loamy range site (10 to 14 inch precipitation zone).

394/CD – Cushman-Bowbac association, rolling

This association consists of rolling soils on upland hills, ridges, and valley side slopes at elevations between 3,800 and 5,000 feet. This association is about 55 percent Cushman loam, 6 to 15 percent slopes, and about 45 percent Bowbac sandy loam, 6 to 15 percent slopes. Neither soil occupies any particular position in the landscape in relation to each other, and their occurrence is dependent upon the type of parent material present. The Cushman soil has light sandy clay loam subsoils and is underlain with bedrock at depths of 20 to 40 inches. The Bowbac soil has sandy clay loam subsoils and is underlain with bedrock at depths of 20 to 40 inches.

Included with this association in mapping are small areas of Tassel and Thedalund soils. The Tassel soil usually occurs in association with the Bowbac soil. It has a paralithic contact between 10 and 20 inches. The Thedalund soil usually occurs in association with the Cushman soil. It lacks an argillic horizon and has paralithic contact at depths of 20 to 40 inches. These inclusions make up about 10 percent of the total acreage.

The Cushman soil is a moderately deep, well-drained soil. It formed in calcareous, moderately alkaline materials derived from sedimentary shales. The average annual precipitation ranges from 10 to 14 inches, and the average annual air temperature is about 44°F.

In a representative Cushman profile the surface layer is light brownish gray loam about 4 inches thick. The subsoil is light brown very fine sandy clay loam about 13 inches thick. The substratum is grayish light brown very fine sandy loam about 6 inches thick and is underlain with soft very fine-grained sandstone and loamstone bedrock at a depth of 23 inches.

The Cushman soil has a moderate permeability. Effective rooting depth ranges from 20 to 40 inches. Available water capacity is moderate. Surface runoff is moderate to rapid and the hazard of erosion is moderate to severe.

The Bowbac soil is a moderately deep, well-drained soil. It formed in polylithologic parent materials derived from sedimentary bedrock. The average annual precipitation ranges from 10 to 40 inches, and the average annual air temperature is about 47°F.

In a representative Bowbac profile the surface layer is brown sandy loam about 4 inches thick. The subsoil is brown sandy clay loam about 13 inches thick. The substratum is light gray very fine sandy clay loam about 12 inches thick which is underlain with calcareous interbedded shale and sandstone at a depth of 29 inches.

The Bowbac soil has a rapid permeability. Effective rooting depth ranges from 20 to 40 inches. Available water capacity is moderate. Surface runoff is moderate and the hazard of erosion is severe.

This association is used for rangeland, wildlife habitat, and dryland cultivation.

Cushman soils: Capability unit VIe2, dryland; Loamy range site (10 to 14 inch precipitation zone).

Bowbac soils: Capability unit VIe5, dryland; Sandy range site (10 to 14 inch precipitation zone).

8.0 1978-79 SOILS SERIES DESCRIPTIONS

Haverson Series*

Typical Pedon: Haverson clay loam – rangeland (colors are for dry soil unless otherwise noted)

A1 0-4" Brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; medium and fine subangular blocky structure; hard, very friable, sticky and plastic; slightly calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

AC 4-12" Grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky and plastic; slightly calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

C1 12-22" Yellowish brown (10YR 5/4) clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; slightly calcareous; mildly alkaline (pH 7.8); clear smooth boundary.

C2 22-40" Yellowish brown (10YR 5/4) clay loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, very sticky and plastic; slightly calcareous; mildly alkaline (pH 7.8); clear smooth boundary.

C3 40-92" Light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; massive; hard, friable, very sticky and plastic; slightly calcareous; mildly alkaline (pH 7.8); gradual wavy boundary.

C4r 92-100" Calcareous olive brown soft weathered claystone.

Type Location: TL-1 North Butte Area, Campbell County, Wyoming.

Note: All soil horizons were sampled at this type location. The C3 (40-92") horizon was subsampled: 40-58", 58-68", 68-84", and 84-92".

* Haverdad

Fort Collins Series*

Typical Pedon: Fort Collins loam – Rangeland (colors are for dry soil unless otherwise noted)

A1 0-4" Brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structures; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.

B1 4-7" Brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; hard, very friable, sticky and slightly plastic; neutral (pH 7.2); clear smooth boundary.

B1 4-7" Brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine angular structure; hard, very friable, sticky and slightly plastic; neutral (pH 7.2); clear smooth boundary.

B21t 7-16" Brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate coarse and medium prismatic structure that parts to moderate coarse and medium subangular blocks; hard, friable, sticky and plastic; few patches of glossy coatings on faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B22t 16-27" Yellowish brown (10YR 5/4) clay loam, dark brown (10YR 4/3) moist; moderate coarse and medium prismatic structure that parts to coarse and medium angular blocks; very hard, firm, sticky and plastic; patches of wax-like coatings on faces of peds, in root channels and lips of the larger pores; mildly alkaline (pH 7.5): clear smooth boundary.

B3ea 27-42" Yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) moist; weak medium and fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; very few patches of glossy coatings on faces of peds; calcareous only in locations of large soft rounded masses; mildly alkaline (pH 7.6); gradual smooth boundary.

Cca 42-60" Light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; strongly calcareous, lime mainly disseminated; mildly alkaline (pH 7.8).

Type Location: TL-2 North Butte Area, Campbell County, Wyoming.

* Forkwood

OLNEY SERIES*

Typical Pedon: Olney sandy loam – Rangeland (colors are for dry soil unless otherwise noted)

A1 0-2" Brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable, slightly sticky; neutral (pH 7.2); clear smooth boundary.

B1 2-4" Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate coarse and medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.

B2t 4-15" Reddish brown (10YR 5/6) sandy clay loam, dark yellowish brown (10YR 4/4) moist; strong coarse prismatic structure that parts to strong coarse subangular blocks; hard, friable, sticky and plastic; patches of wax-like coatings on faces of peds, along root channels and lips of large pores; mildly alkaline (pH 7.5); clear smooth boundary.

B3 15-25" Reddish brown (10YR 5/6) sandy clay loam, dark reddish brown (10YR 4/6) moist; moderate coarse prismatic structure that parts to moderate coarse and medium subangular blocks; hard, very friable, sticky and plastic; calcareous in a few spots; mildly alkaline (pH 7.6); gradual smooth boundary.

Cca 25-60" Reddish brown (10YR 5/6) sandy loam, dark reddish brown (10YR 4/6) moist; massive; soft, very friable, slightly sticky and slightly plastic; strongly calcareous, lime mainly disseminated; moderately alkaline (pH 8.0).

Type Location: TL-3 North Butte Area, Campbell County, Wyoming.

* Hiland

CUSHMAN SERIES

Typical Pedon: Cushman loam – Rangeland (colors are for air dry soil unless otherwise noted).

Al 0-2" Brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak medium and fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral (pH 7.2); clear smooth boundary.

B1 2-5" Brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate medium and fine subangular blocks; hard, friable, sticky and plastic; mildly alkaline (pH 7.4); clear smooth boundary.

B2t 5-15" Yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure that parts to moderate coarse and medium subangular blocks; hard, friable, sticky and plastic; patches of glossy and wax-like coatings on faces of peds and lips of large pores; mildly alkaline (pH 7.5); clear smooth boundary.

B3 15-23" Light reddish brown (10YR 6/6) sandy clay loam, yellowish brown (10YR 4/4) moist; weak medium and fine subangular blocky structure; hard, very friable, sticky and plastic; calcareous in spots; mildly alkaline (pH 7.6); gradual smooth boundary.

C1 23-34" Light reddish brown (l0YR 6/6) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, sticky and slightly plastic; calcareous in spots; mildly alkaline (pH 7.6); clear wavy boundary.

C2r 34-46" Soft weathered calcareous sandstone.

Type Location: TL-4 North Butte Area, Campbell County, Wyoming.

BOWBAC SERIES

Typical Pedon: Bowbac sandy loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-2" Brown (10YR 5/3) sandy loam, dark brown (10 YR 4/3) moist; weak fine granular structure; soft, very friable, slightly sticky; neutral (pH 7.2); clear smooth boundary.

B1 2-4" Yellowish brown (10YR 5/4) sandy loam, dark brown (10 YR 4/3) moist; moderate medium and fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.

B2t 4-15" Yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure that parts to moderate coarse and medium subangular blocks; slightly hard, very friable, sticky and plastic; thin nearly continuous glossy coatings and patches of wax-like coatings on faces of peds; clay bridging between sand grains; mildly alkaline (pH 7.5); gradual smooth boundary.

B3 15-21" Yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium and fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.6); gradual smooth boundary.

C1ca 21-35" Light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, slightly sticky; strongly calcareous; lime mainly disseminated; moderately alkaline (pH 8.0); gradual wavy boundary.

C2r 35-50" Soft weathered brown calcareous sandstone.

Type Location: TL-5 North Butte Area, Campbell County, Wyoming.

THEDALUND SERIES*

Typical Pedon: Thedalund loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-4" Brown (10YR 5/3) loam, dark brown (10 YR 4/3) moist; weak fine and very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; mildly calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

C1 4-22" Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

C2r 22-32" Soft weathered calcareous brown loamstone.

Type Location: TL-6 North Butte Area, Campbell County, Wyoming.

Note: This series was sampled at this location. Each soil horizon was sampled.

The resultant laboratory data shows less clay in the 10 to 22 inch textural control section (14.6%) than the 18% lower limit allowed for the Thedalund Series. Experience has shown, however, that higher silt and lower clay readings are obtained by the hydrometer method used here. Better correlation is obtained between the pipette method and field textures, especially in areas of montmorillonite clays.

* Theedle

CUSHMAN SERIES

Typical Pedon: Cushman loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-2" Light brown (10YR 6/3) loam, brown (10 YR 5/3) moist; weak, medium and fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.6); clear smooth boundary.

B2t 2-10" Light yellowish brown (10YR 6/4) loam, brown (10YR 5/3) moist; moderate medium prismatic structure that parts to moderate medium and fine subangular blocks; hard, friable, sticky and plastic; patches of glossy and wax-like coatings on faces of peds, in root channels, and lips of large pores; calcareous in spots; mildly alkaline (pH 7.6); clear smooth boundary.

B3ca 10-18" Light yellowish brown (10YR 6/4) loam, brown (10YR 5/3) moist; moderate coarse and medium subangular blocky structure; hard, very friable, sticky and plastic; strongly calcareous; mildly alkaline (pH 7.8); gradual smooth boundary.

C1ca 18-34" Light yellowish brown (10YR 6/4) loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

C2r 34-46" Soft weathered calcareous brown loamstone.

Type Location: TL-7 North Butte Area, Campbell County, Wyoming.

Note: This series was sampled at this location. Each soil horizon was sampled.

The resultant laboratory data shows less clay in the 2 to 18 inch textural control section (weighted average 16.6%) than the 18% lower limit allowed for the Cushman Series. Experience has shown, however, that higher silt and lower clay readings are obtained by the hydrometer method used here. Better correlation is obtained between the pipette method and field textures, especially in areas of montmorillonite clays.

TASSEL SERIES*

Typical Pedon: Tassel sandy loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-3" Brown (10YR 5/3) sandy loam, dark brown (10 YR 4/3) moist; weak, very fine granular structure; soft, very friable, mildly alkaline (pH 7.4); clear smooth boundary.

C1 3-12" Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable; slightly calcareous; mildly alkaline (pH 7.6); gradual wavy boundary.

C2r 12-20" Calcareous yellowish brown soft weathered sandstone.

Type Location: TL-4 North Butte Area, Campbell County, Wyoming.

* Taluce

NELSON SERIES *

Typical Pedon: Nelson sandy loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-3" Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; mildly alkaline (pH 7.4); clear smooth boundary.

C1 3-23" Yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; soft, very friable; slightly calcareous; mildly alkaline (pH 7.5); gradual wavy boundary.

C2r 23-30" Slightly hard calcareous yellowish brown weathered sandstone.

Type Location: TL-9 North Butte Area, Campbell County, Wyoming.

* Turnercrest

BIDMAN SERIES *

Typical Pedon: Bidman loam – Rangeland (colors are for air dry soil unless otherwise noted)

A2 0-3" Light grayish brown (10YR 5/2) loam dark grayish brown (10YR 4/2) moist; think viscular crust, weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; neutral (pH 7.2); abrupt smooth boundary.

B2t 3-21" Brown (10YR 5/3) clay, dark grayish brown (10YR 4/2) moist; strong coarse prismatic structure that parts to strong coarse and medium angular blocks; extremely hard, very firm, very sticky and plastic; nearly continuous wax-like coatings on faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B3ca 21-26" Light brown (10YR 6/3) clay loam, brown (IOYR 5/3) moist; moderate coarse prismatic structure that parts to moderate coarse and medium angular blocks; very hard, firm, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C1ca 26-52" Light brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, sticky and plastic; strongly calcareous; moderately alkaline (pH 8.2); gradual wavy boundary.

C2r 52-60" Slightly hard, weathered, mixed calcareous sandstone, siltstone and shale.

Type Location: TL-10 North Butte Area, Campbell County, Wyoming.

Note: This series was sampled at this location for soil analysis. All soil horizons were sampled.

BRIGGSDALE SERIES*

Typical Pedon: Briggsdale fine sandy loam – Rangeland (colors are for air dry soil unless otherwise noted).

A2 0-2" Light grayish brown (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine and very fine granular structure; soft, very friable; neutral (pH 7.2); abrupt smooth boundary.

B21t 2-6: Dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3.5/3) moist; moderate coarse prismatic structure, parts to moderate coarse angular blocks; hard, firm, sticky, plastic; thin nearly continuous glossy coating on faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B22t 6-11" Dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3.5/3) moist; strong coarse prismatic structure that parts to strong coarse and medium angular blocks; very hard, very firm, very sticky and plastic; thin nearly continuous glossy coatings and patches of wax-like coatings on all faces of peds; mildly alkaline (pH 7.4); clear smooth boundary, B3 11-20" Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure that parts to weak coarse and medium angular blocks; hard, friable, sticky and plastic; mildly alkaline (pH 7.5); clear smooth boundary.

C1ca 20-30" Very pale brown (I0YR 7/3) sandy clay loam, light brown (10YR 6/3) moist; weak coarse subangular blocky structure; hard, friable, sticky and slightly plastic; very strongly calcareous; moderately alkaline (pH 8.0)' gradual wavy boundary.

C2r 30-60" Soft calcareous weathered pale brown sandy shale.

Type Location: TL-11 North Butte Area, Campbell County, Wyoming.

* Parmleed

BIDMAN SERIES

Typical Pedon: Bidman loam – Rangeland (colors are for air dry soil unless otherwise noted)

A2 0-2" Light grayish brown (10YR 6/2) fine dandy loam, dark grayish brown (10YR 4/2) moist; moderate fine and very fine granular structure; soft, very friable, neutral (pH 7.2); abrupt smooth boundary.

B21t 2-7" Dark grayish brown (10YR 4.5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure that parts to moderate coarse and angular blocks; very hard, firm, very sticky and plastic; thin nearly continuous glossy coatings on faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B22t 7-16" Dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3.5/3) moist; strong medium prismatic structure that parts to strong medium and fine angular blocks; very hard, very firm, very sticky and plastic; thin nearly continuous glossy coatings and patches of wax-like coatings on all faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B3 16-22" Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure that parts to weak coarse and medium angular blocks; hard, friable, sticky and plastic; mildly alkaline (pH 7.5); clear smooth boundary.

C1ca 22-40" Very pale brown (10YR 7/3) sandy clay loam, light yellowish brown (10YR 6/3) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; very strongly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

C2r 40-52" Soft calcareous weathered pale brown sandy shale.

Type Location: TL-12 North Butte Area, Campbell County, Wyoming.

BIDMAN SERIES

Typical Pedon: Bidman loam – Rangeland (colors are for air dry soil unless otherwise noted)

A2 0-3" Light grayish brown (10YR 6/2) loam dark grayish brown (10YR 4/2) moist; moderate fine and very fine granular structure; soft, very friable; neutral (pH 7.2); abrupt smooth boundary.

B21t 3-7" Dark yellowish brown (10YR 4/4) clay loam, dark brown (10YR 3.5/3) moist; moderate coarse prismatic structure that parts to moderate coarse and medium angular blocks; hard, firm, sticky and plastic; thin nearly continuous glossy coatings on faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B22t 7-14" Dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3.5/3) moist; strong medium prismatic structure that parts to strong medium and fine angular blocks; very hard, very firm, very sticky and plastic; thin nearly continuous glossy coatings and patches of wax-like coatings on all faces of peds; mildly alkaline (pH 7.4); clear smooth boundary.

B3 14-18" Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure that parts to weak coarse and medium angular blocks; hard, friable, sticky and plastic; mildly alkaline (pH 7.5); clear smooth boundary.

Clca 18-40" Very pale brown (10YR 7/3) sandy clay loam, light yellowish brown (10YR 6/3) moist; massive; hard, friable, sticky and plastic; very strongly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

C2r 40-50" Soft calcareous weathered pale brown sandy shale.

Type Location: TL-13 North Butte Area, Campbell County, Wyoming.

FORT COLLINS SERIES*

Typical Pedon: Fort Collins sandy loam – Rangeland (colors are for air dry soil unless otherwise noted)

A1 0-2" Brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate fine and very fine granular structure; slightly hard, very friable, slightly sticky, noncalcareous; clear smooth boundary.

B21t 2-5" Brown (7.5YR 5/4) sandy clay loam (having less than 35% fine or coarse sands), dark brown (7.5YR 5/4) moist; moderate very coarse prismatic structure that parts to moderate very coarse and coarse sub-angular blocks; hard, friable, slightly sticky and slightly plastic; clay bridging between sand grains; noncalcareous; clear smooth boundary.

B22t 5-11" Brown (10YR 5/4) sandy clay loam (having less than 35% fine sand or coarser), dark brown (7.5YR 4/4) moist; strong coarse prismatic structure that parts to strong coarse and medium angular blocks; hard, friable; slightly sticky and slightly plastic; clay bridging between sand grains; noncalcareous; clear smooth boundary.

B3 11-35" Light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak coarse and moderate subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; gradual smooth boundary.

Cca 35-50" Light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 4/4) moist; massive; soft, very friable, strongly calcareous.

Type Location: TL-15 North Butte Area, Campbell County, Wyoming.

* Forkwood

9.0 1978-79 SOIL ANALYTICAL RESULTS

Bidman (Sample Point TL-10)

Depth (inches)	Mechanical Analysis				
	Very Fine Sand (%)	Sand (%)	Silt (%)	Clay (%)	Texture
0-3	16.4	15.2	52.8	15.6	SiL
3-21	5.0	16.6	37.8	40.6	C
21-26	12.6	37.0	26.8	23.6	SCL
26-52	17.9	28.9	30.4	22.8	L

Depth (inches)	Se (ppm)	Organic Matter (%)	Saturation (%)
0-3	<0.1	2.60	49.0
3-21	0.1	1.68	61.5
21-26	0.3	0.95	46.6
26-52	<0.1	0.87	50.4

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	6.5	0.5	4.0	2.0	0.1	0.1
3-21	6.1	0.3	1.7	1.0	0.2	0.1
21-26	7.7	0.3	1.9	1.3	0.2	0.1
26-52	7.9	0.3	1.5	1.5	0.7	0.6

Samples analyzed by Core Laboratories for Cleveland Cliffs – August 1979.

Haverson* (Sample Point TL-1)

Depth (inches)	Mechanical Analysis Very Fine Sand (%)	Sand (%)	Silt (%)	Clay (%)	Texture
0-4	6.0	30.8	34.8	28.4	CL
4-12	7.5	23.3	39.2	30.0	CL
12-22	11.1	27.7	31.2	30.0	CL
22-40	11.0	19.8	37.2	32.0	CL
40-58	10.9	29.9	28.0	31.2	CL
58-68	11.1	13.7	42.0	33.2	CL
68-84	8.3	24.5	32.0	35.2	CL
84-92	8.3	36.5	26.0	29.2	CL

Depth (inches)	Se (ppm)	Organic Matter (%)	Saturation (%)
0-4	0.1	3.84	64.4
4-12	0.1	2.75	59.5
12-22	<0.1	1.30	50.3
22-40	0.1	1.30	52.4
40-58	<0.1	1.47	49.6
58-68	<0.1	0.87	58.1
68-84	<0.1	0.92	52.8
84-92	<0.1	0.58	44.7

Depth (inches)	pH paste	Saturation Extract Elect. Cond. (mmhos/cm)	Cations Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-4	6.8	0.7	6.2	1.8	0.3	0.1
4-12	6.9	0.6	5.3	1.4	0.1	<0.1
12-22	7.5	0.3	2.8	0.7	0.1	0.1
22-40	7.7	0.3	2.3	0.6	0.1	0.1
40-58	7.7	0.2	2.0	0.6	0.1	0.1
58-68	7.7	0.2	1.7	0.5	0.1	0.1
68-84	7.8	0.2	1.6	0.5	0.1	0.1
84-92	7.8	0.3	1.8	0.5	0.1	0.1

Samples analyzed by Core Laboratories for Cleveland Cliffs – August 1979.

* Haverdad

Cushman (Sample Point TL-7)

Depth (inches)	Mechanical Analysis				
	Very Fine Sand (%)	Sand (%)	Silt (%)	Clay (%)	Texture
0-2	22.9	27.9	38.8	10.4	L
2-10	16.2	32.6	35.8	15.4	L
10-18	11.5	41.3	29.2	18.0	SL
18-34	12.7	38.9	32.8	15.6	L

Depth (inches)	Se (ppm)	Organic Matter (%)	Saturation (%)
0-2	0.1	2.23	50.5
2-10	0.1	2.20	55.0
10-18	0.1	1.01	49.3
18-34	0.1	0.78	46.0

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-3	7.2	0.6	5.2	1.3	0.1	<0.1
3-21	7.1	0.4	4.0	1.1	0.1	<0.1
21-26	7.7	0.3	2.7	1.2	0.1	0.1
26-52	7.9	0.3	2.0	1.3	0.1	0.1

Samples analyzed by Core Laboratories for Cleveland Cliffs – August 1979.

Thedalund* (Sample Point TL-6)

Depth (inches)	Mechanical Analysis				
	Very Fine Sand (%)	Sand (%)	Silt (%)	Clay (%)	Texture
0-4	23.4	24.2	40.8	11.6	L
4-22	21.9	21.7	41.8	14.6	L

Depth (inches)	Se (ppm)	Organic Matter (%)	Saturation (%)
0-4	<0.1	2.83	53.9
2-22	<0.1	1.88	57.9

Depth (inches)	pH paste	Saturation Extract				
		Elect. Cond. (mmhos/cm)	Cations			
			Ca (mg/L)	Mg (mg/L)	Na (mg/L)	SAR (mg/L)
0-4	7.4	0.5	4.8	0.8	0.1	<0.1
4-22	7.4	0.4	3.1	0.8	0.1	0.1

Samples analyzed by Core Laboratories for Cleveland Cliffs – August 1979.

* Theedle

APPENDIX D7
SOILS

List of Tables

Table D7-1 Soil Mapping Unit Acreages

Map Designation	Description (soil series, slope percent)	Acreage	Percent
50/AB	Bidman clay loam, 0 to 6	89.5	9.0
BO	Bowbac sandy loam, 6 to 15	89.6	9.1
PA	Parmleed clay loam, 6 to 10	49.0	4.9
75/BC	Cushman loam, 3 to 10	114.1	11.5
b45/AB	Forkwood loam, 0 to 6	44.9	9.6
1A	Haverdad, 0 to 3	11.3	1.1
KI/AB	Kishona loam, 0 to 6	5.7	0.6
a62/AB	Hiland loam, 0 to 6	31.7	3.2
a62/C	Hiland fine sandy loam, 6 to 10	12.9	1.3
Re/C	Renohill loam, 6 to 14	2.8	0.3
SH	Shingle clay loam, 3 to 30	15.8	1.6
SH-G	Shingle clay loam, gullied	131.6	13.3
151/DE	Shingle-Rock Outcrop, 10 to 60	29.8	3.0
347/D	Shingle-Rock Outcrop-Samday, 10 to 30	152.1	15.4
TA	Taluce sandy loam, 15 to 40	55.1	5.6
TH	Theedle loam, 3 to 15	23.0	2.3
TE	Terro sandy loam, 6 to 15	18.5	1.9
TUR	Turnercrest loam, 3 to 10	6.5	0.7
354/AB	Ulm-Bidman assoc., gently sloping	33.2	3.4
394/CD	Cushman-Bowbac assoc., rolling	12.9	1.3
Zg/B	Zigweld loam, 3 to 6	3.9	0.4
D	Disturbed	5.1	0.5
	TOTALS	**989.0**	**100.0**

Table D7-2 North Butte Topsoil Volume Determination

Map Designation	Description	Acreage Depth (inches)	Estimated Volumes (cubic yards)
50/AB	Bidman clay loam	60	721,967
BO	Bowbac sandy loam	36	433,664
PA	Parmleed clay loam	36	237,160
75/BC	Cushman loam	36	552,244
b45/AB	Forkwood loam	60	765,527
1A	Haverdad	30	45,577
KI/AB	Kishona loam	60	45,980
a62/AB	Hiland loam	60	255,713
a62/C	Hiland fine sandy loam	60	104,060
Re/C	Renohill loam	30	11,293
SH	Shingle clay loam	15	31,863
SH-G	Shingle clay loam, gullied	6	106,157
151/DE	Shingle-Rock Outcrop	6	24,039
347/D	Shingle-Rock Outcrop-Samday	6	122,694
TA	Taluce sandy loam	15	111,118
TH	Theedle loam	36	111,320
TE	Terro sandy loam	36	89,540
TUR	Turnercrest loam	36	31,460
354/AB	Ulm-Bidman	60	267,813
394/CD	Cushman-Bowbac	36	62,436
Zg/B	Zigweld loam, 3 to 6	60	31,460
D	Disturbed	0	0
		TOTALS	**4,163,085**

APPENDIX D7
SOILS

List of Plates

The following 1 Drawing specifically referenced Appendix D7 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

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APPENDIX D7
SOILS

List of Attachments

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325

SOIL & OVERBURDEN ANALYSIS FEE SCHEDULE
1987

PARAMETER	METHOD	UNIT	PRICE
Acid-base Potential	(1) p 43-51	T CaCO3/100T	$15.00
Acid Potential, Furnace Oxidation	(1) p 43-51	meq H/100g	10.00
Ammonia as N, NaCl ext.	(3) met. 84-2	ppm	5.00
Arsenic, Hot Water ext.	(3) met 80-3	ppm	8.00
Barium	(4) p 600-2	ppm	5.00
Base Saturation		%	20.00
Beryllium	(4) p 600-2	ppm	5.00
Boron	(3) met 75-4	ppm	5.00
Cadmium	(4) p 600-2	ppm	5.00
Calcium, sat. paste	(5) met 2,3a	meq/l	5.00
Cation Exchange Capacity	(3) met 57-2	meq/100g	15.00
Chromium	(4) p 600-2	ppm	5.00
Coarse Fragments	(10) 205,213-216	%	5.00
Conductivity, sat. paste	(5) met 3a,4b	mmhos/cm	4.50
Copper	(4) p 600-2	ppm	5.00
'yanide	(2) 335.2 CLP-M	ppm	45.00
Exchangeable Sodium Percentage	(8)	%	25.00
Iron	(4) p 600-2	ppm	5.00
Lead	(4) p 600-2	ppm	5.00
Lime	(5) met 23c	%	5.00
Magnesium, saturated paste ext.	(4) met 2,3a	meq/l	5.00
Manganese	(4) p 600-2	ppm	5.00
Mercury	(2) 245.5	ppm	8.00
Molybdenum (MT) amm. oxal.	(3) met 74-2	ppm	8.00
Molybdenum (WY)(NH4)2CO3	(6)	ppm	8.00
Molybdenum (WY) ABDTPA	(9)	ppm	5.00
Neutralization Potential	(1) p 43-51	T CaCO3/100T	5.00
Nickel	(4) p 600-2	ppm	5.00
Nitrate as N	(3) met 84-2	ppm	5.00
Total Nitrogen			15.00
Organic Carbon	(3) 29-3	%	5.00
Organic Matter	(5) p 105	%	5.00
pH, saturated paste	(5) met 21a	Std. units	4.00
Phosphorus, Sodium Bicarbonate	(3) met 73-4	ppm	5.00
Potassium	(3) met 71.3	ppm	5.00
SAR (includes Ca, Ng, Na)	(5) met 20b	unitless	15.00
Saturation Percentage	(5) 2,3a	%	4.50
Selenium	(3) met 80-3	ppm	8.00
Silver	(2) 245.5	ppm	5.00
Sodium, extractable	(5) met 18	meq/100g	5.00
Sodium, available	(5) met 18	meq/100g	5.00
Sodium, sat. paste ext.	(5) met 2,3a	meq/l	5.00
Sulfur Forms, Furnace Oxidation	(8)	%	18.50
Texture (PSA) sand, silt, clay	(7)	%	5.00
Very Fine Sand	140/270 mesh	%	4.50
Zinc	(4) p 600-2	ppm	5.00

SOIL & OVERBURDEN ANALYSIS FEE SCHEDULE
1987

REFERENCES

(1) Mine Spoil Pot. Soil/Water Quality, R.M. Smith
(2) EPA-600/4-79-020, USEPA 1979
(3) Methods of Soil Analysis, ASA Mono #9
(4) Soil Science Society of America, Vol. 35 #4,1
(5) USDA Handbook #60, USDA 1954
(6) Procedure from WY D.E.Q., VLEK, 1975
(7) USDA Handbook #18
(8) Field & Laboratory Methods, Sobek, 1978
(9) Procedure from WY D.E.Q.
(10) Soil Survey Manual

United States Department of Agriculture
Soil Conservation Service
201 W. Lakeway Road, Suite 900
Gillette, Wyoming 82716

RECEIVED MAR 17 1988

March 15, 1988

Mr. Gary Saunders
Applied Ecosystems
P. O. Box 1817
Casper, Wyoming 82602

Gary Saunders,

On March 9, 1988, I reviewed the soils maps for Uranerz, USA's proposed permit areas on the Ruth property in Johnson County and the North Butte property in Campbell County. There are no soils in these permit areas that will qualify as Prime Farmland.

Paul Lupcho

Paul Lupcho
Soil Scientist
Soil Conservation Service
201 W. Lakeway, Suite 900
Gillette, Wyoming 82716

PL:ge

ADDENDUM D7-1
SOILS UPDATE

Table of Contents

Please note: All tables and plates are located behind the tabs following this Addendum.

Tables

Plates

ADDENDUM D7-1
SOILS UPDATE

1.0 INTRODUCTION

The "North Butte Uranium ISR Project" has been permitted for commercial operation (WDEQ/LQD Permit #632) since March of 1989 (revised in 1990). Power Resources, Inc. dba Cameco Resources (CR) is updating the existing permit (**Appendix D7**). A Soils Update Report (**Addendum D7-1**) has been prepared for the approximate 1010-acre permit area and is intended to be compatible with: Wyoming Department of Environmental Quality (DEQ), Land Quality Division (LQD) requirements and standards as described in LQD Rules and Regulations Chapter 11 Section 3(a)(iii) and (iv); Guideline No.4 (In-Situ Mining) Attachment III (Topsoil and Subsoil Management and the Associated Erosion Control at Uranium In Situ Leaching Operations); and guidance provided in LQD Guideline No.1 (Topsoil and Overburden).

Plate D7-1.1 is a revised soils map that supersedes the previous soils map (**Plate D7-1**, Soils, revised 4-15-93). Recommended soil salvage depths, for both topsoil and subsoil are included in **Table D7-1.1** (Update) in the soils update report (**Addendum D7-1**). Similar to the preexisting study, depth of "suitable" soil for each soil series and map unit was provided. In this case (**Table D7-1.1**) topsoil and subsoil depths are differentiated. Landowner preferences have been incorporated into the topsoil salvage plan and are presented in the Operations Plan. The initial soils update work included a thorough review of the existing **Appendix D-7** soils information (both soil map unit and soil series descriptions provided in each of the two previous soil survey reports for the North Butte project) and soils mapping as shown on the previous soils map. A check for any new soils regulatory information issued since 1990 was also completed. Soil suitability and recommended salvage depths were also rechecked and revised as appropriate. A determination of whether additional soil sampling was necessary was made. Finally, a revised project soils map was completed. Some lands adjacent to the project area were also included in the soils mapping.

The identification and proper management of the soil resources is essential for the success of reclamation in the affected areas and the achievement of the post-action land use. The information presented in this update report is designed to aid in formulating a practical and successful soils management and reclamation plan. For this report, information concerning soil survey methodology is incorporated directly into the applicable Results sections.

2.0 RESULTS

The North Butte Permit Area is considered to have an average annual precipitation range of 10 to 14 inches and therefore is within an "ustic-aridic" soil precipitation regime. Average annual air temperature is about 47 degrees Fahrenheit (F) and therefore is within a “mesic” soil temperature regime. About 105 to 130 annual frost free days (growing season) exist within the North Butte permit area (Westerman and Prink, 2004). In addition, no prime farmland was previously found to exist on the permit area and none exists today as well (SCS, 1988).

2.1 Review of Previous Soils Information

Two previous soil surveys (1978/1979 and 1988) have been completed on the North Butte permit area and the full reports are contained in the existing North Butte **Appendix D7**. In October 1992, approximately 50 acres of adjacent lands along the southern border of the permit area’s eastern arm were mapped and incorporated into the permit boundary. The primary objective of both soil surveys was to define the existing topsoil resource within the survey area and to determine the extent, availability, and suitability of soil materials for use in reclamation. Since that time, the NRCS (formerly the Soil Conservation Service) has published the “Soil Survey of Campbell County, Wyoming, Southern Part” which includes the North Butte area (Westerman and Prink, 2004).

1978/1979 Soil Conservation Service (SCS)/Cleveland Cliffs Soil Survey

Soil Conservation Service personnel (now the Natural Resources Conservation Service, NRCS), working with a Cleveland Cliffs Iron Company consultant, completed a soil survey in 1978 and 1979 on an aerial photo composite base map of the permit area, corrected for distortion, at a detailed scale of 1”=500’. Ten established SCS Campbell County soil mapping units were utilized for the survey. The following is a list of those map unit symbols, names, and slope ranges. A few new soil names have been inserted, where appropriate, to show which names have changed and been recorrelated to new names:

Map Unit 1A:	Haverson (now Haverdad) loam, 0 to 3% slopes
Map Unit b45:	Fort Collins (now Forkwood) loam, 0 to 6% slopes
Map Unit 50/AB:	Bidman loam, 0 to 6% slopes
Map Unit a62/AB:	Olney (now Hiland) fine sandy loam, 0 to 6% slopes
Map Unit a62/C:	Olney (now Hiland) fine sandy loam, 6 to 10% slopes
Map Unit 75/BC:	Cushman very fine sandy loam, 3 to 6% slopes
Map Unit 151/DE:	Shingle-Rock Outcrop complex, 10 to 60% slopes
Map Unit 347/D:	Shingle-Rock Outcrop-Samsil (now Samday) complex, 10 to 30% slopes
Map Unit 354/AB:	Ulm-Bidman association, gently sloping
Map Unit 394/CD:	Cushman-Bowbac association, rolling

Fifteen typical soil profile descriptions (TL-1 through TL-15) were completed for these soils and four of the soils were sampled for laboratory analysis (TL-1, Haverson; TL-6, Thedalund, now Theedle; TL-7, Cushman; and TL-10, Bidman). The sample site locations were specifically selected to adequately represent the soils of the areas to be disturbed and were taken from within those areas. The soils were analyzed according to the parameters listed in the current DEQ Guideline 1 at that time. The 1978/1979 soil survey included complete map unit descriptions, soil series profile descriptions, and all laboratory data for the sampled soils, including pH, EC, saturation percent, SAR, organic matter percent, Selenium (ppm), and texture including very fine sand percent. Evaluation of the field and laboratory data, as well as discussion with SCS (now NRCS), indicated no problems regarding soil suitability, including the fact that there were no salinity problems with the soils of the survey area.

1988 Western Environmental, Inc. Soil Survey –Summary

Western Environmental, Inc. (Randy White) completed a new detailed Order 1-2 soil survey of the North Butte permit area in 1988 according to specifications in DEQ Guideline 1 (November 1984). The original Western Environmental study is included in **Appendix D7**. The soil boundaries were delineated on a 1"=500' scale photo-base map (updated as **Plate D7-1.1**) and the previous 1978/1979 soils description and sampling sites were retained on the map. All 10 of the previous soil map units were retained in the 1988 survey and 13 new map units were set up and delineated in the new survey as well as Disturbed (Map Unit D). The following is a list of those map unit symbols, names, and slope ranges.

Map Unit BO:	Bowbac sandy loam, 6 to 15% slopes
Map Unit PA:	Parmleed (formerly Briggsdale) loam, 6 to 10% slopes
Map Unit KI/AB:	Kishona loam, 0 to 6% slopes
Map Unit Re/C:	Renohill loam, 6 to 14% slopes
Map Unit SH:	Shingle clay loam, 3 to 30% slopes
Map Unit SH-G:	Shingle clay loam, gullied
Map Unit SM:	Samday (formerly Samsil), silty clay, 3 to 30% slopes
Map Unit TA:	Taluce (formerly Tassel), 15 to 40% slopes
Map Unit TH:	Theedle (formerly Thedalund) loam, 3 to 15% slopes
Map Unit TE:	Terro sandy loam,6 to 15% slopes
Map Unit TUR:	Turnercrest (formerly Nelson) loam, 3 to 10% slopes
Map Unit UL:	Ulm silty clay, 3 to 6% slopes
Map Unit Zg/B:	Zigweid loam, 3 to 6% slopes

Seventeen typical soil profile descriptions (88-1 through 88-17) were completed for these soils and all 17 were sampled for laboratory analysis (88-1, Bidman; 88-2, Ulm; 88-3, Cushman; 88-4, Hiland (formerly Olney); 88-5, Zigweid; 88-6, Forkwood (formerly Fort Collins); 88-7, Hiland (formerly Olney); 88-8, Turnercrest (formerly Nelson); 88-9, Bowbac; 88-10, Terro (formerly Terry); 88-11, Parmleed (formerly Briggsdale); 88-12, Kishona; 88-13, Forkwood (formerly Fort Collins); 88-14, Taluce (formerly Tassel); 88-15, Samday (formerly Samsil); 88-16, Parmleed (formerly Briggsdale); and 88-17, Renohill.

The sample site locations were staked in the field and their locations plotted on the field map. The soils were analyzed according to the parameters listed in the DEQ Guideline 1 at that time. The 1988 soil survey included complete map unit descriptions, soil series profile descriptions, and all laboratory data for the sampled soils, including pH, EC, saturation percent, SAR, organic carbon percent, calcium carbonate (lime) percent, Selenium (ppm), Boron (ppm), texture (percent sand, silt, and clay), and coarse fragment content (percent).

Soil suitability was evaluated for each sampled soil and an "average depth of material appearing suitable" was listed for each soil series in its profile description. The updated recommended soil salvage depths are listed in **Table D7-1.1**. Soil salvage commitments are presented in the Operations Plan.

2.2 Completion of Revised Soils Baseline Map

A primary objective of the soils update report was to confirm, revise (as necessary), and transfer the soils mapping (the soil map unit delineations – polygons) from the existing base map to a new, more current, and better base map (**Plate D7-1.1**). As stated above, the existing soils base map was a 1"=500' scale photo-base map dated at least 1988 or older. Although the permit area topography has not changed since that date, map technology has, and this older map does not meet modern map standards. The previous map was produced as a plastic "mylar" with inked soil delineation lines and map unit symbols. Map copies were produced as "blue-line" copies which were printed from the original inked mylar. Either because the original mylar was very dark to begin with, or the image was perhaps "screened" for some reason, the resulting blue-line copies were so dark that in some areas the soil lines could not be distinguished from the dark background.

An additional factor which affected the readability of the map was the inclusion of a circuitous, curvilinear "wellfield outline" boundary line very similar in line width and density to the soil lines. In many locations, it was very difficult to tell whether a particular line was a soil delineation line or a wellfield boundary line. For this reason as well as the need to provide an updated, more readable soils map, a new or updated soils map was created (**Plate D7-1.1**).

The new base map was created using the most recently available photo imagery, specifically flown for this project and dated July 2010. Five foot contours and land survey (sections) overlays are presented on this map. The resulting 1"=500' scale base map is excellent and is also an electronic file. The base map was created by Data Map, Inc. (Flight Date: July 27, 2010).

Jim Nyenhuis, Certified Professional Soil Scientist/Soil Classifier (ARCPACS 2753), took the new base map and completed the soils mapping task in the field. The previous soils map was used to the full extent possible. Soil delineation lines (polygons) that were legible were field checked and then transferred to the new base map. All previous soil description/sample sites that were legible were also transferred to the new base map. Several sample site locations were added later through measurement based on the written location information contained in the original soil profile descriptions. Some areas with significant illegibility were remapped to the Order 1-2 level using the existing soils legend and standard field work methods, as specified in Guideline No.1 (WDEQ, 1996) and the procedures and standards of the National Cooperative Soil Survey (Soil Survey Staff, 1993 and 1999; and Schoeneberger et al., 2002). Several areas adjacent to the permit area were also included in the soils mapping. No new soils were identified and no additional soil samples were collected for reasons explained in the following sections of this update report.

2.3 DEQ New Regulatory Soils Management Specifications

DEQ has provided new guidance for the management of topsoil and subsoil resources at In-Situ Recovery Operations (ISR) as described in their Guideline No.4 (In-Situ Mining) "Attachment III – Topsoil and Subsoil Management and the Associated Erosion Control at Uranium In Situ Leaching Operations" (WDEQ, 2000). T-Chair Livestock Company, the private surface landowner, has presented very specific requirements towards the salvage and handling of topsoil. These requirements are in letters provided by the landowner, which are provided as an addendum to the Operations Plan. These letters require that topsoil stockpiles be minimized and that CR and DEQ recognize and employ the landowner's method of road construction. This prescribed methodology is presented in the Operations Plan. Topsoil and subsoil salvage concepts are summarized in the following sections. Erosion control is discussed in the Operations and Reclamation plans.

Attachment III was finalized subsequent to the approval of the North Butte ISR permit document and is referenced as part of the CR soils update report. DEQ requires approval of any alternative soil handling procedures prior to use of those procedures in the field, or before approval of any permitting actions, if alternative soil handling procedures are proposed. The objective of the DEQ topsoil and subsoil management plan for ISR projects is to "minimize disturbance to the topsoil/subsoil and premine vegetation resource, thereby allowing the postmining land use conditions to be established".

Attachment III stresses that the mining company limit areas of disturbance during wellfield delineation, construction, and operation by minimizing temporary access roads, and segregating topsoil and subsoil materials during mud pit, pipeline, wellfield construction, and other excavations. Topsoil and subsoil are generally not stripped and stockpiled for the entire wellfield area. Soil salvage in specific wellfield areas where traffic is concentrated (within the wellfield pattern area) may be necessary in site specific situations. Commitments and procedures for limiting surface disturbance are provided in the Operations Plan.

Attachment III (Section IV, Baseline Characterization of the Soil Resource) states that initially the entire permit area should be soil surveyed to at least the Order 3 level of intensity (the standard level of intensity for an NRCS county soil survey). In areas where disturbance may take place, the Applicant shall complete either an Order 1-2 soil survey or a program of digging soil verification holes on a 3-acre grid spacing. For the North Butte permit area, the Western Environmental Inc. 1988 soil survey was done to the detailed Order 1-2 level and the current soils update (this report) mapping confirmation/revision and transfer to the new orthophoto base map was also done to the Order 1-2 level of detail. As part of the 1978/1979 and 1988 soil surveys, a total of at least 31 typical soil profiles have been described and 21 of these profiles have been fully sampled by major horizons and subhorizons for subsequent laboratory analysis. Many of these sampled soils are located within areas of projected surface disturbance according to current North Butte project specifications.

As a result of the previous, detailed North Butte Order 1-2 soil survey and the extensive soil sampling for laboratory analysis, and because all previous soils laboratory results indicate "suitable" soil material, it was suggested that no additional soil sampling was necessary as part of the North Butte soils update process. This issue was discussed with Mr. Jon Sweet, WDEQ Soil Scientist, and he concurred that no additional soil sampling seemed necessary at this time (Sweet, 2010).

2.4 Topsoil/Subsoil Salvage Specifications at Facilities Areas and Roads

<u>Permanent or Long-Term Facilities Areas</u>

Concerning soil salvage, DEQ Attachment III states that suitable topsoil (A and E horizons) and subsoil (B and C horizons) should be salvaged from "permanent or long-term facilities areas, associated pad (parking) areas, and long-term storage areas". Salvaged soil should be stored in long-term stockpiles. For this permit purposes, long-term is defined as surface disturbance that lasts longer than one year; short-term surface disturbance typically lasts less than six months but may extend up to one year. For the North Butte project, long-term facilities would include the proposed plant site and parking area, the proposed surge pond area, ancillary buildings and satellite facilities. All topsoil salvage commitments are included in the Operations Plan.

<u>Temporary Structures and Storage Areas</u>

Attachment III goes on to state that topsoil and subsoil are generally not salvaged from areas having temporary structures used for short-term construction activity or storage. However, "topsoil and perhaps subsoil should be stripped where it is likely that the soil will be adversely affected by compaction due to repetitive traffic or contaminated by fuel, oil, grease, drilling mud or other such construction materials". Furthermore, Attachment III states "The LQD should be consulted when such sites are planned for storage. The conditions, characteristics, duration, and types of items to be stored should be considered before a decision is made to strip soil from these storage areas".

All topsoil salvage commitments are included in the Operations Plan.

Primary Access Roads

A Primary Access Road is a road constructed at an ISR facility that may necessitate 'cut and fill' activities with gravel surfacing, or other material, and is constructed for long-term use. These roads are typically used for routine access to the main facility areas including office areas, satellite facilities and include all haul roads. All topsoil salvage commitments are included in the Operations Plan.

Secondary Access Roads

Secondary access roads are constructed progressively and will extend from primary access roads to header houses as wellfield installation proceeds. These roads usually include a gravel surface. All topsoil salvage commitments are included in the Operations Plan.

Monitoring Well Access Roads

These designated travel ways are typically two-track trails that are located such that the number and length of roads are minimized. Sensitive areas such as springs and wetlands are avoided. Travel should be limited to light-duty vehicle use. Attachment III states "The topsoil and subsoil are generally not salvaged from these roads". This is discussed further in the Operations Plan.

Drilling Mud Pit Construction

Drilling and mud pit construction, equipment laydown, pipeline construction and traffic are the primary wellfield disturbances during construction. These disturbances are considered temporary. All topsoil salvage commitments are included in the Operations Plan.

2.5 Recommended Topsoil and Subsoil Salvage Depths for Long-Term and Short-Term Disturbances

As stated in the Introduction, the previous 1988 Western Environmental, Inc. North Butte Order 1-2 soil survey provided a total depth of "suitable" soil material but did not differentiate topsoil depth from subsoil depth. Suitable depths ranged from 6 to 15 inches for shallow soils (4 to 20 inches to bedrock), 30 to 36 inches for moderately deep soils (20 to 40 inches to bedrock), and 60 inches for very deep soils (60 inches or deeper to bedrock).

All of the soils on the North Butte permit area are "suitable" for use in reclamation without significant physical or chemical limitations. The suitability evaluation followed parameters and threshold values contained in Table I-2 "Criteria to establish suitability of topsoil (or topsoil substitutes)" of Guideline No.1 "Topsoil and Overburden" (WDEQ, 1996). Unsuitability threshold values include: pH <5.0 or > 9.0, EC >12; SAR >15, or

SAR >12 for soils with greater than 40% clay; coarse fragment content >35%; saturation percent <25% or >80% (marginal rated); and sand, clay, or silty clay texture (marginal rated) (WDEQ, 1996).

Because DEQ Attachment III states that suitable topsoil should be salvaged and stockpiled separately from suitable subsoil, a differentiation of suitable topsoil and subsoil depths for each soil and map unit has been completed as part of the soils update report (**Addendum D7-1**). The soil/subsoil depths (topsoil and subsoil) are listed in **Table D7-1.1** (Update). Topsoil volumes for salvaged soils are included in the Operations Plan.

A revised interpretation of what is topsoil and subsoil has been applied for the North Butte soils update based on extensive previous experience with Powder River Basin soils. Topsoil, for soil salvage purposes, is considered the combination of not only the surface layer (A or E horizon) but also the upper part of the underlying "B" horizon subsoil layer, which usually is a transition layer with good organic matter content, good soil structure, many plant roots, and good soil texture. The combined thickness of the surface layer and underlying transition layer often ranges from about 6 to 18 inches in depth. Subsoil includes the dominant middle part of the "B" horizon as well as the lower part of the "B" horizon and may include the upper part of the underlying "C" horizon substratum. This concept of subsoil excludes the lower part of the "C" horizon which can often have hard to extremely hard, dry consistency, massive structure, little organic matter content, few to no plant roots, and good to poor soil chemistry. This lower "C" horizon material often will meet suitability criteria but is not being recommended for subsoil salvage because of the better soil material that overlies it and the intent to not dilute the better material through mixing with the lower "C" horizon material. As additional support, it should be noted that NRCS (formerly SCS) terminology defines "C" horizon soil as "substratum" material, not "subsoil" which is used only for "B" horizons (SCS, 1993).

In summary, CR has reviewed and field checked the historic soils mapping and found that the work completed in 1978/79 and 1988 was comprehensive. CR has prepared an updated soils map that clearly presents this historic data and identified field check locations. No new soil types were identified. CR has updated soil suitability depths in accordance with the 2000 guidance: Guideline No.4 (In-Situ Mining) "Attachment III – Topsoil and Subsoil Management and the Associated Erosion Control at Uranium In Situ Leaching Operations" (WDEQ, 2000). CR has incorporated the landowner's, (T-Chair Ranch) desires in their topsoil handling and storage plan. All topsoil salvage commitments are included in the Operations Plan.

3.0 REFERENCES

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ADDENDUM D7-1
SOILS

List of Tables

Table D7-1.1 List of Soil Map Units and Recommended Soil Salvage Summary

Map Unit Symbol*	Map Unit Name	Soil Sample Location Number	Total Soil Depth (in.)*	Long Term* Topsoil/Subsoil Salvage (in.)	Short Term* Topsoil/Subsoil Salvage (in.)	Limitations to Deeper Salvage
50/AB	Bidman clay loam, 0 to 6% slopes	TL-10, TL-12, TL-13	60	12/18	12/18	Soil entirely suitable but upper 30" better
BO	Bowbac sandy loam, 6 to 15% slopes	88-9, TL-5	36	12/18	12/18	Soil entirely suitable but upper 30" better
PA	Parmleed loam, 6 to 10% slopes	88-11, 88-16, 88-11	36	12/18	12/18	Soil entirely suitable but upper 30" better
75/BC	Cushman loam, 3 to 10% slopes	88-3, TL-4, TL-7	36	12/18	12/18	Soil entirely suitable but upper 30" better
b45/AB	Forkwood loam, 0 to 6% slopes	88-6, 88-13, TL-2, TL-15	60	12/24	12/24	Soil entirely suitable but upper 36" better
1A	Haverdad loam, 0 to 3% slopes	TL-1	30	12/12	12/12	Soil entirely suitable but upper 24" better
KI/AB	Kishona loam, 0 to 6% slopes	88-12	60	12/18	12/18	Soil entirely suitable but upper 30" better
a62/AB	Hiland loam, 0 to 6% slopes	88-4, TL-3	60	12/24	12/24	Soil entirely suitable but upper 36" better
a62/C	Hiland fine sandy loam, 6 to 10% slopes	88-7	60	12/24	12/24	Soil entirely suitable but upper 36" better
Re/C	Renohill loam, 6 to 14% slopes	88-17	30	12/12	12/12	Soil entirely suitable but upper 24" better
SH	Shingle clay loam, 3 to 30% slopes	TL-14	15	6/6	6/6	Soil entirely suitable but upper 12" better
SH-G	Shingle clay loam, gullied	sampled in SH	6	6/0	6/0	Soil entirely suitable, salvage all soil
SM	Samday silty clay, 3 to 30% slopes	sampled in 347D	12	6/6	6/6	Soil entirely suitable, salvage all soil
151/DE	Shingle-Rock Outcrop, 10 to 60% slopes	sampled in SH	Sh: 6 RO: 0	Sh: 6/0 RO: 0/0	Sh: 6/0 RO: 0/0	Salvage all Shingle 6"
347/D	Shingle-Rock Outcrop-Samday, 10 to 30% slopes	Sa: 88-15	Sh: 6 RO: 0 Sa: 6	Sh: 6/0 RO: 0/0 Sa: 6/0	Sh: 6/0 RO: 0/0 Sa: 6/0	Salvage all Shingle and Samday 6"
TA	Taluce sandy loam, 15 to 40% slopes	88-14, TL-8	15	6/6	6/6	Soil entirely suitable but upper 12" better

Map Unit Symbol*	Map Unit Name	Soil Sample Location Number	Total Soil Depth (in.)*	Long Term* Topsoil/Subsoil Salvage (in.)	Short Term* Topsoil/Subsoil Salvage (in.)	Limitations to Deeper Salvage
TH	Theedle loam, 3 to 15% slopes	TL-6	36	12/18	12/18	Soil entirely suitable but upper 30" better
TE	Terro sandy loam, 6 to 15% slopes	88-10	36	12/12	12/12	Soil entirely suitable but upper 24" better
TUR	Turnercrest loam, 3 to 10% slopes	88-8, TL-9	36	12/18	12/18	Soil entirely suitable but upper 30" better
354/AB	Ulm-Bidman, gently sloping	U: 88-2 B: 88-1	60	12/18	12/18	Soil entirely suitable but upper 30" better
394/CD	Cushman-Bowbac, rolling	sampled in75/BC and BO	36	12/18	12/18	Soil entirely suitable but upper 30" better
UL	Ulm silty clay, 3 to 6%slopes	sampled in 354/AB	60	12/18	12/18	Soil entirely suitable but upper 30" better
Zg/B	Zigweid loam, 3 to 6% slopes	88-5	60	12/18	12/18	Soil entirely suitable but upper30" better
D	Disturbed Land	--	--	0	0/0	No soil to salvage
RL	Reclaimed Land	--	--	6/6	6/6	Salvage only upper 12"
W	Water	--	--	0	0/0	No soil to salvage

ADDENDUM D7-1
SOILS

List of Plates

The following 1 Drawing specifically referenced Appendix D7 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

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APPENDIX D8
VEGETATION INVENTORY

Table of Contents

Photos

Please note: All tables, figures, plates, and attachments are located behind the tabs following this Appendix. Photos are located at the end of this Appendix (page D8-8).

Tables

Figures

Plates

Attachment

Addenda

APPENDIX D8
VEGETATION INVENTORY

1.0 INTRODUCTION

Power Resources, Inc. doing business as Cameco Resources (CR) has updated this section in response to comments received from the Wyoming Department of Environmental Quality (DEQ), Land Quality Division (LQD). Updated vegetation data is presented in **Addendum D8-1**. Prior to implementing baseline studies for the licensing of the North Butte ISL Project, meetings were held between LQD and Pathfinder to determine the requirements for the vegetation baseline. It was determined that the previous owner, Uranerz, would not need site specific production and cover data for the North Butte site if they used the Extended Reference Area (EXREFA) concept. Uranerz would, however, need to provide a vegetation map, discuss the communities and species present and provide a comparison of vegetation studies previously conducted in the region.

Further, it was agreed that the existing vegetation data would be acceptable in lieu of a new study provided that the existing data were generally confirmed, that the threatened and endangered species surveys were updated, and that the plant species list was updated and verified. Also, a written integration of existing vegetation surveys in the region was agreed upon to be included along with assumptions, differences, and deficiencies which may result from such a combination. Verification surveys of existing North Butte data were conducted by Applied ECOsystems. The reports from the four area vegetation investigations have previously been submitted to the LQD and the NRC. The four investigations are as follows:

1. Uranerz Ruth R & D Vegetation Report; 1981
2. Cleveland Cliffs North Butte Vegetation Report; 1979
3. Cleveland Cliffs Greasewood Creek Vegetation Report; 1980
4. Cleveland Cliffs Regional Vegetation Survey Report; 1978

These reports are included in **Addendum D8-1**.

In October, 1992, Pathfinder incorporated into the permit boundary approximately 50 acres of adjacent lands (incidental boundary revision - IBR), located along the southern border of the permit area's eastern arm. The vegetation within the IBR area was previously surveyed by Cleveland Cliffs in 1978-79, when the proposed permit area was larger than that currently in place. **Plate D8-1** has been updated to include the vegetation types within the IBR area. The updated **Plate D8-1.1** is included in **Addendum D8-1**. The vegetation types within the IBR area are the same as those for the current permit area, with the exception that no juniper-grassland type is present.

The IBR area will only be used for the installation of perimeter ore zone monitor wells, therefore no changes have been made to **Table D8-2**, affected acreage.

2.0 VEGETATION TYPES (MAPPING UNITS)

For the North Butte permit area, four mapping units were used to delineate the vegetation types (**Table D8-1**, **Figure D8-1**). The mapping units are sagebrush-grassland, grassland, bottomland and juniper-sagebrush. The following sections provide a description of each mapping unit. **Tables D8-1** and **D8-2** present acreages and percentages for the vegetation types in the permit area and within affected areas. The vegetation types are shown in **Photographs 1 through 4**, taken in 1988. **Photographs la through 4a**, taken in April, 1993, show the three vegetation types present within the IBR area. Locations for the photographs are shown on **Figure D8-1**.

2.1 Sagebrush-Grassland

The sagebrush-grassland vegetation type generally occurs in both upland and lowland areas and is characterized by the presence of big sagebrush (Artemisia tridentata) and grasses which include western wheatgrass (Agropyron smithii), blue grama (Bouteloua gracilis), needle-and-thread (Stipa comata), green needlegrass (Stipa viridula) and prairie junegrass (Koeleria cristata). Other common species include threadleaf sedge (Carex filifolia), brome (Bromus spp.), fringed sagewort (Artemisia frigida) and pricklypear cactus (Opuntia polyacantha).

The sagebrush-grassland vegetation type comprises 646.7 acres or 62.2 percent of the permit area. This type also comprises 207.2 acres or 60.4 percent of the affected area.

2.2 Grassland

The grassland vegetation type occupies 358.75 acres or 34.5 percent of the permit area and 129.3 acres or 37.7 percent of the affected area. This type occurs on level to sloping upland sites, along ridgetops and in areas where disturbances from previous exploration activities have been reclaimed. The grassland type is characterized by the dominance of grasses and grasslike species including western wheatgrass (Agropyron smithii), blue grama (Bouteloua gracilis), needle-and-thread (Stipa comata), green needlegrass (Stipa viridula) and prairie junegrass (Koeleria cristata). Other common species include threadleaf sedge (Carex filifolia) and brome (Bromus spp.). Big sagebrush (Artemisia tridentata) occurs in the grassland type but to a lesser extent than it is found in the sagebrush-grassland type.

2.3 Bottomland

The bottomland vegetation type occurs in lowland areas along streams and washes. This type occupies 25.75 acres or 2.5 percent of the permit area and approximately 5.7 acres or 1.7 percent of the affected area. Vegetation in this type is characterized primarily by grasses including western wheatgrass, meadow barley (Hordeum brachyantherum), bluegrass (Poa spp.), Timothy (Phleum pratense) and green needlegrass. Other common species include brome, western yarrow (Achillea millefolium), lupine (Lupinus spp), prairie clover (Petalosteman spp.) and common dandelion (Taraxacum officinale). The Plains cottonwood (Populus deltoides) is found as scattered individuals along Willow Creek in the bottomland type.

2.4 Juniper-Sagebrush

The juniper-sagebrush vegetation type is found on shallow soils of the steep slopes of North Butte and on the slopes of washes near the butte. This vegetation type occupies 8.1 acres or less than one percent of the permit area and is characterized by the presence of (Juniperus scopulorum).

2.5 Species List

Plant species observed on the North Butte permit area are listed in **Table D8-3**. Seven noxious weed species quackgrass (Agropyron repens), western ragweed (Ambrosia psliostachva), burdock (Arctium minus), Canada thistle (Cirsium arvense), Cheatgrass brome (Bromus tectorum), Tansy mustard (Descurainia pinnata) and American licorice (Glycyrrhiza lepidota) were encountered on the permit area. Although these species are scattered throughout the permit area, none of them comprise a dominant species individually or in combination over a contiguous area of greater than 3 acres. Also, one selenium indicator, two-grooved Milkvetch (Astragalus bisulcatus) was encountered.

3.0 STUDY COMPARISONS

This section contains a comparison of cover and productivity data from studies conducted on the North Butte permit area and others done in the region. Information was obtained from studies conducted at the following uranium properties:

Studies	Data Collected By
Uranerz – Ruth Property	NUS
Cleveland Cliffs – North Butte Property	Kilbourn/NUS & CCI staff
Cleveland Cliffs – Greasewood Creek Property	Mine Reclamation Consultants
Cotter Corp. – Charlie Property	Mariah
Malapai Resources – Christensen Ranch Property	Mariah
Wyoming Mineals – Irigaray Property	Mariah

In using data from these various studies several differences in the sites and the studies need to be pointed out. These sites, although in the same general region (see **Figure D8-1**) they each have their own localized geographical settings and are located in two different drainage basins (Powder River and Belle Fourche). Due to the different geographical settings, differences in structural composition of the vegetation will occur because of the different environmental conditions (soil, slope, microclimates, etc.) that will prevail. The Ruth property is located a few miles east of Pine Ridge along the Dry Fork of the Powder River with elevations ranging from about 4,800 to 5,000 feet. The North Butte property is located adjacent to North Pumpkin Butte (elevation 6,050 feet) in the Powder River drainage basin, and is bisected by numerous deeply incised drainages. The elevation at the North Butte property ranges in elevation from 4,900 to 5,700 feet. The Greasewood Creek property is located in gently rolling uplands of the Belle Fourche River drainage basin. Elevations on the property range from about 5,160 to 5,300 feet. The Christensen Ranch and Charlie properties are essentially the same area. They are located just west of North Pumpkin Butte in the Powder River drainage basin with elevations ranging from about 4,500 to 5,400 feet. The topography consists of rolling prairie with numerous drainages and Cottonwood bottomlands. The Irigaray property is located just east of the Powder River and is characterized by broad valleys and gently rolling uplands which have been extensively dissected. Elevations range from about 4,200 feet along the Powder River to 4,700 feet.

Another difference is that these studies, done over a nine year period, were conducted according to the DEQ Vegetation Guideline which has undergone a number of revisions during that time period. What was considered adequate in 1978 may not be adequate in 1988, and as such, some deficiencies in data are to be expected.

These studies were also conducted by different individuals over the years which would tend to add variability in mapping and map unit descriptions. Also, even though the studies were conducted according to the guideline, each person setting up and conducting a study could unknowingly be adding some bias that would cause differences between the studies. As previously mentioned, these sites are in the same general region, but each site may have different vegetative characteristics.

Since the referenced studies were conducted over a nine year period, seasonal variability (wet years and dry years) could significantly affect the vegetative productivity. Grazing practices and land use by the landowners prior to conducting the surveys would also affect the productivity, and species composition of the study areas.

In spite of the above mentioned differences which can be expected when comparing data from these studies, it is felt that sufficient similarity exists to provide an adequate picture of the existing environment at the North Butte site. Even though current site specific data and tests of sample adequacy are lacking for the North Butte site, subsequent sampling of the EXREFA's and the reclaimed areas will provide sufficient data to determine the success of reclamation.

In the following sections two tables compare productivity and cover data at some of the study sites. Site specific data for the Ruth R & D study, the Cleveland Cliffs North Butte regional and Greasewood Creek studies are provided in **Attachment D8-1**. Data from the Christensen Ranch and Irigaray studies can be found in the respective license application documents.

3.1 Productivity

Table D8-4 presents productivity data from various studies in the region.

These production numbers, while rather hard to compare due to different terminologies for the vegetation types, it is apparent that the lowland/bottomland types have the greatest production, over 100g/m^2, while the upland types tend to range between 40 to 60 g/m^2.

3.2 Cover Data

Total Vegetative cover data for several studies in the region are presented in **Table D8-5**.

As can be seen in the Table, the riparian and bottomland types, as expected, have the highest percentage of ground cover while grassland and sagebrush areas are lower but tend to be somewhat equal to each other with regards to percentage of ground cover. These data are thought to be indicative of conditions to be found throughout the North Butte permit area.

4.0 EXTENDED REFERENCE AREA

One Extended Reference Area (EXREFA) was selected adjacent to the North Butte permit area. This area, shown on **Figure D8-1** is located primarily in a grassland area and will be used in determining reclamation/revegetation success after mining. This EXREFA was located outside of the North Butte permit area to avoid disturbance during mining activities. Two views of the EXREFA, taken in 1988, are shown on **Photographs 5 and 6**. A third photograph (**Photograph 5a**) was taken on April 5, 1993, which shows the sagebrush/grassland vegetation type located within the southwestern/central portion of the EXREFA.

5.0 LAND USE AND GRAZING HISTORY

The following information on land use and grazing was provided by Mr. Brown, landowner of the lands located within the permit area.

Livestock grazing has been the historical land use in the permit area for many years although there has been some intermittent uranium production and exploration activity and oil and gas activity. Cattle are the primary domestic livestock that currently utilize the rangeland within the permit area, although sheep and horses are also grazed in the area at times. To improve the grass on the permit area, the landowner commonly burns sagebrush during the spring.

6.0 VALUE OF MAJOR VEGETATION SPECIES

Vegetation species present on the permit area can provide information on the area's ability to support the existing land use of livestock grazing. The post-mining reclamation/revegetation efforts will attempt to establish species that will support the planned land use of livestock grazing. The value of some of the major vegetative species are discussed below:

Agropyron smithii is a native, cool-season, sod forming grass with very strong rhizomes. This grass is palatable and nutritious when green in spring and moderately so during other times of the year. Its vigorous rhizomes make it one of the more tolerant of the desirable and abundant grasses to grazing pressure and drought. As a genus, Agropyron is fairly important to livestock and wildlife.

Stipa comata is a cool-season perennial bunchgrass that begins growing in early spring. It provides fair to good forage, especially when green. If grazed during the time awns are present, physical injury may result to eyes, mouth, and flesh of sheep. Larger livestock seldom are bothered. It is best grazed before awns appear or after they drop. It is seldom planted because of the undesirable awns.

Poa secunda is one of the first grasses to green-up in early spring. During early spring to early summer, it is palatable to all classes of livestock, becoming somewhat less preferred in the summer when cured. By autumn, it is frequently selected by all livestock again.

Bouteloua gracilis is a warm season sod forming short grass. Although normally low in productivity, it is nutritious to all classes of livestock even during the winter.

Bromus japonicus and B. tectorum are annuals common on disturbed areas. These species are generally considered undesirable forage species and are palatable only as a green plant in the autumn and spring.

Oryzopsis hymenoides is a native cool-season, densely tufted bunchgrass. It is an excellent forage with both leaves and seeds relished by livestock throughout the year.

Koeleria cristata is a short-lived perennial bunchgrass occurring as small tufts. When green it is good forage palatable to all livestock, becoming less preferred with maturity. It is easily overgrazed because it greens earlier than most other native grasses and becomes less abundant as grazing pressures increase.

Carex filifolia is valuable as an early green forage, since it begins to green in early April. During this time, it is highly palatable, becoming tough and dry by late June. On medium to coarse textured soils, it increases with heavy grazing pressure by cattle but decreases with similar pressure by sheep. On fine textured soils abundance decreases with use by either kind of livestock.

Artemisia tridentata, the most abundant shrub on the permit area, is generally an undesirable forage species for livestock. Its nutritive value is frequently exceptionally high but because of bitter resins it is often low in palatability.

Artemisia cana, another shrub common on the permit area, is generally of little value for summer grazing. It does furnish good to excellent browse in fall and winter for all classes of livestock. It is perhaps the best of the Artemisia genus for forage, being particularly useful when snow cover is deep.

7.0 SUMMARY

The North Butte ISL permit area is located in a semi-arid region with severe winters, cool summers and about 14 inches of precipitation annually. Grasses on the site are primarily cool-season, sod-forming and bunchgrasses. Artemisia tridentata is the dominant shrub species on the permit area. Along Willow Creek, numerous Populus deltoides are found. Junipers are common on the slopes of North Butte and the drainages leading away from the Butte.

The permit area encompasses approximately 1,039 acres and supports four vegetation types. These types and their respective percentages on the permit area are as follows:

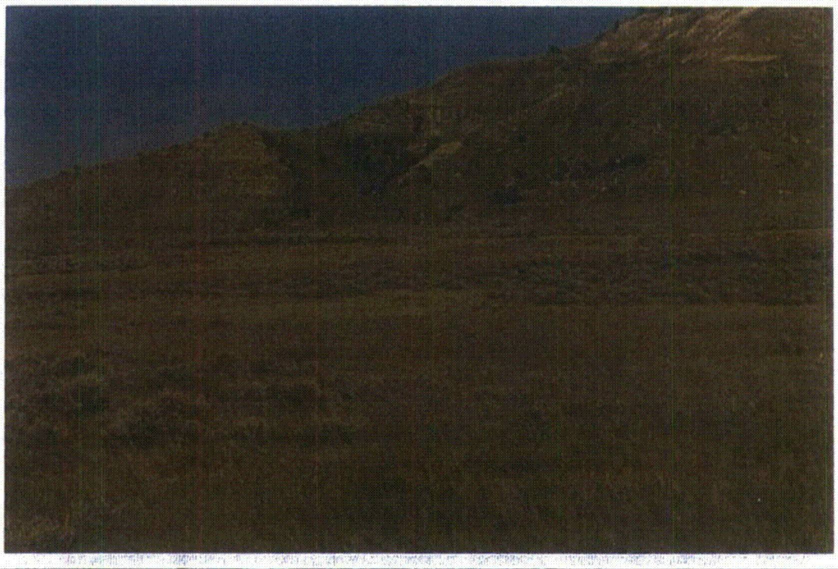
Sagebrush/Grassland	62.2%
Grassland	34.5%
Bottomland	2.5%
Juniper/Sagebrush	0.8%

A total of 120 plant species were identified on the permit area. Of these, five noxious weed species and one selenium indicator species were encountered during field surveys. No plant species currently listed or proposed for listing as threatened or endangered by the U.S. Fish and Wildlife Service were observed on the permit area.

One Extended Reference Area was established in an area that will not be disturbed for the life of the mine. This area will be used to evaluate post-mining revegetation success.

The permit area is currently used as rangeland for domestic livestock and provides wildlife habitat.

Photographs 1 and 2
Sagebrush/Grassland Vegetation Type
With Interspersed Grasslands



Photographs 3 and 4
Grassland Mixed with Sagebrush/Grassland
Junipers Visible on North Butte

Photograph 1a
Sagebrush/Grassland Vegetation Type
Western Portion of IBR Area; April 5, 1993

Photograph 2a
Grassland Vegetation Type
Eastern Portion of IBR Area; April 5, 1993

Photograph 3a
Bottomland Vegetation Type
IBR Area; April 5, 1993

Photograph 4a
Sagebrush/Grassland (Distant), bottomland (Middle) and
Grassland (Foreground) Vegetation Types
IBR Area, April 5, 1993

Photographs 5 and 6
Views of the North Butte EXREFA

Photograph 5a
Sagebrush/Grassland and Grasslands Vegetation Types
Reference Area; April 5, 1993

APPENDIX D8
VEGETATION INVENTORY

List of Tables

Table D8-1 Vegetation Type Acreages for the North Butte Permit Area

Vegetation Type	Acreage	Percent of Permit Area
Sagebrush-Grassland	646.7	62.2
Grassland	358.75	34.5
Bottomland	25.75	2.5
Juniper-Sagebrush	8.1	0.8
Total	**1039.3**	**100.0**

Table D8-2 Vegetation Type Acreages for Affected Areas on the North Butte Permit Area

Vegetation Type	Acreage Affected	Percent of Affected Acreage	Percent of Total Vegetation Type Affected
Sagebrush-Grassland	207.2	60.4	34.2
Grassland	129.3	37.7	38.3
Bottomland	5.7	1.7	24.5
Juniper-Sagebrush	0.8	0.2	10.0
Total	**343.0**	**100.0**	

Table D8-3 Vegetation Species List

Life Form	Scientific Name	Common Name
Grass	Agropyron cristatum	Crested Wheatgrass
	Agropyron dasystachyum	Thickspike Wheatgrass
	Agropyron repens	Quackgrass
	Agropyron riparium	Streambank Wheatgrass
	Agropyron smithii	Western Wheatgrass
	Agropyron spicatum	Bluebunch Wheatgrass
	Agropyron spicatum-inerme	Bearless Bluebunch-Wheatgrass
	Agropyron trachyaulum	Slender Wheatgrass
	Agropyron trichophorum	Pubescent Wheatgrass
	Aristida longiseta	Red Three-Awn
	Bouteloua gracilis	Blue Grama
	Bramus inermis	Smooth Brome
	Bromus japonicas	Japanese Brome
	Bromus tectorum	Cheatgrass Brome
	Calamovilfa longifolia	Prairie Sandreed
	Distichlis stricta	Inland Saltgrass
	Elymus Canadensis	Canada Wildrye
	Elymus ciereus	Basin Wildrye
	Festuca spp.	Fescue
	Hordeum jubatum	Foxtail Barley
	Koeleria cristata	Prairie Junegrass
	Oryzopsis hymenoides	Indian Ricgegrass
	Phleum pratense	Common Timothy
	Poa arida	Plains Bluegrass
	Poe canbyi	Canby Bluegrass
	Poa secunda	Sandberg Bluegrass
	Polypogon monspeliensis	Rabbifoot Grass
	Sitanion hystrix	Bottlebrush Squirreltail
	Stipa comata	Needle-and-Thread
	Stipa viridula	Green Needlegrass
Forb	Abronia fragrans	Snowball Sandverbena
	Achillea millefolium	Common Yarrow
	Agoseris glauca	Pale Agoseris
	Allium textile	Textile Onion
	Ambrosia psliostachya	Western Ragweed
	Arctium minus	Burdock
	Asclepias spp.	Milkweed
	Asclepias speciosa	Snowy Milkweed
	Aster adscendens	Longleaf Aster
	Aster falcatus	Whiteprairie Aster
	Astragalus bisulcatus	Twogrooved Milkvetch
	Astragalus geyeri	Geyer Milkvetch
	Astragalus spatulatus	Tufted Milkvetch
	Calochortus Eurycarpus	Mariposalily
	Camelina microcarpa	Littlepod Falseflax
	Casilleja sulphurea	Sulpher Paintbrush
	Cerastium arvense	Starry Cerastium
	Chenopodium album	Lambsquarter Goosefoot
	Cirsium arvense	Canada Thistle
	Cirsium canescens	Thistle

Life Form	Scientific Name	Common Name
Forb (cont'd)	Cirsium vulgare	Bull Thistle
	Cleome serrulata	Bee Spiderflower
	Cryptanth celosioides	Northern Cryptantha
	Delphinium geyeri	Geyer Larkspur
	Descurainia pinnata	Tansymustard
	Erigeron ochroleucus	Fleabane
	Eriogonum brevicaule	Wild Buckwheat
	Eriogonum ovalifolium	Cushion Eriogonum
	Gaura coccinea	Scarlet Gaura
	Glycyrrhiza lepidota	American Licorice
	Grindelia squarrosa	Curlycup Gumweed
	Haplopappus grendeloides	Goldenweed
	Helianthus annus	Common Sunflower
	Heterotheca villosa	Hairy Goldenaster
	Kochia scoparia	Fireweed Summercypress
	Lepidium densiflorum	Prairie Pepperweed
	Lesquerella ludoviciana	Silver Bladderpod
	Lithospermum incisum	Narrowleaf Gromwell
	Lupins argenteus	Silvery Lupine
	Lygodesmia juncea	Rush Skeletonplant
	Machaeranthera canescens	Hoary Aster
	Melilotus alba	White Seetclover
	Melilotus officinalis	Yellow Sweetclover
	Mentha arvensis	Field Mint
	Mertensiz linearis	Bluebell
	Oenothera coronopifolia	Evening Primrose
	Orenothera caespitosa	Gumbo Lily
	Orobanche fasciulata	Broomrape
	Oxytropis lagopus	Locoweed
	Penstemon angustifolia	Narrowleaf Penstemon
	Petalostemon occidentale	Prairie Clove
	Phlox hoodia	Hood Phlox
	Plantago patagonica	Wooly Plantain
	Plantago spinulosa	Spiny Indianwheat
	Psoralea esculenta	Breadroot Scurfpea
	Psoralea lanceolata	Lemon Scurfpea
	Psoralea tenuiflora	Slimflower Scurfpea
	Ranunculus spp.	Buttercup
	Ratibida columinifera	Coneflower
	Rumex crispus	Curly Dock
	Salsola kali	Russianthistle
	Sisymbrium altissimum	Tumbling Hedgemustard
	Sisymbrium linifolium	Tumble Mustard
	Sphaeralcea coccinea	Scarlet Globemallow
	Taraxacum officinale	Common Dandelion
	Thlaspi arvense	Field Pennycress
	Tragopogon dubius	Salsify
	Vicia Americana	American Vetch
	Xanthium strumarium	Cocklebur
	Zigadenus venenosus	Meadow Deathcamas

Life Form	Scientific Name	Common Name
Sub-shrub	Artemesia ludoviciana	Louisiana Sagewort
	Artemisis frigida	Fringed Sagewort
	Artemisia pedatifida	Birdfoot Sagewort
	Ceratoides lanata	Common Winterfat
	Guiterrezia sarothrae	Broom Snakeweed
Shrub	Artemisia cana	Silver Sagebrush
	Artemisia tridentate	Big Sagebrush
	Atriplex canescens	Fourwing Saltbrush
	Chrysothamnus nauseosus	Rubber Rabbitrush
	Chrysothamnus viscidiflorus	Douglas Rabbitbrush
	Juniperus scopulorum	Junipur
	Prunus virginiana	Chockecherry
	Symphoricarpos occidentalis	Snowberry
Tree	Populus deltoids	Eastern Cottonwood
	Pinus flexilus	Limber Pine
Succulent	Opuntia polyacantha	Plains Pricklypear
	Mammillaria vivipara	Ball Cactus
	Yucca glauca	Yucca
Bryophyte	Lichen spp.	Lichen

Table D8-4 Summary of Productivity Data

Vegetation Type	Ruth[1] g/m²	N. Butte[2] g/m²	Greasewood[3] g/m²	Charlie[4] g/m²	Irigaray[5] g/m²	N. Butte[6] g/m²
Grassland		42.4		26	38	54.1
Sagebrush/Grassland		57.1	56.5			44.1
Bottomland Sagebrush				136	150	
Upland Sagebrush			55.1	59	87	
Bottomland		162.3				140
Upland	42.06					
Lowland	131.71					

Notes:
1. Uranerz 1981
2. Cleveland-Cliffs 1979
3. Cleveland-Cliffs 1980
4. Cotter Corp. 1980
5. Wyoming Minerals 1979
6. Cleveland-Cliffs 1978

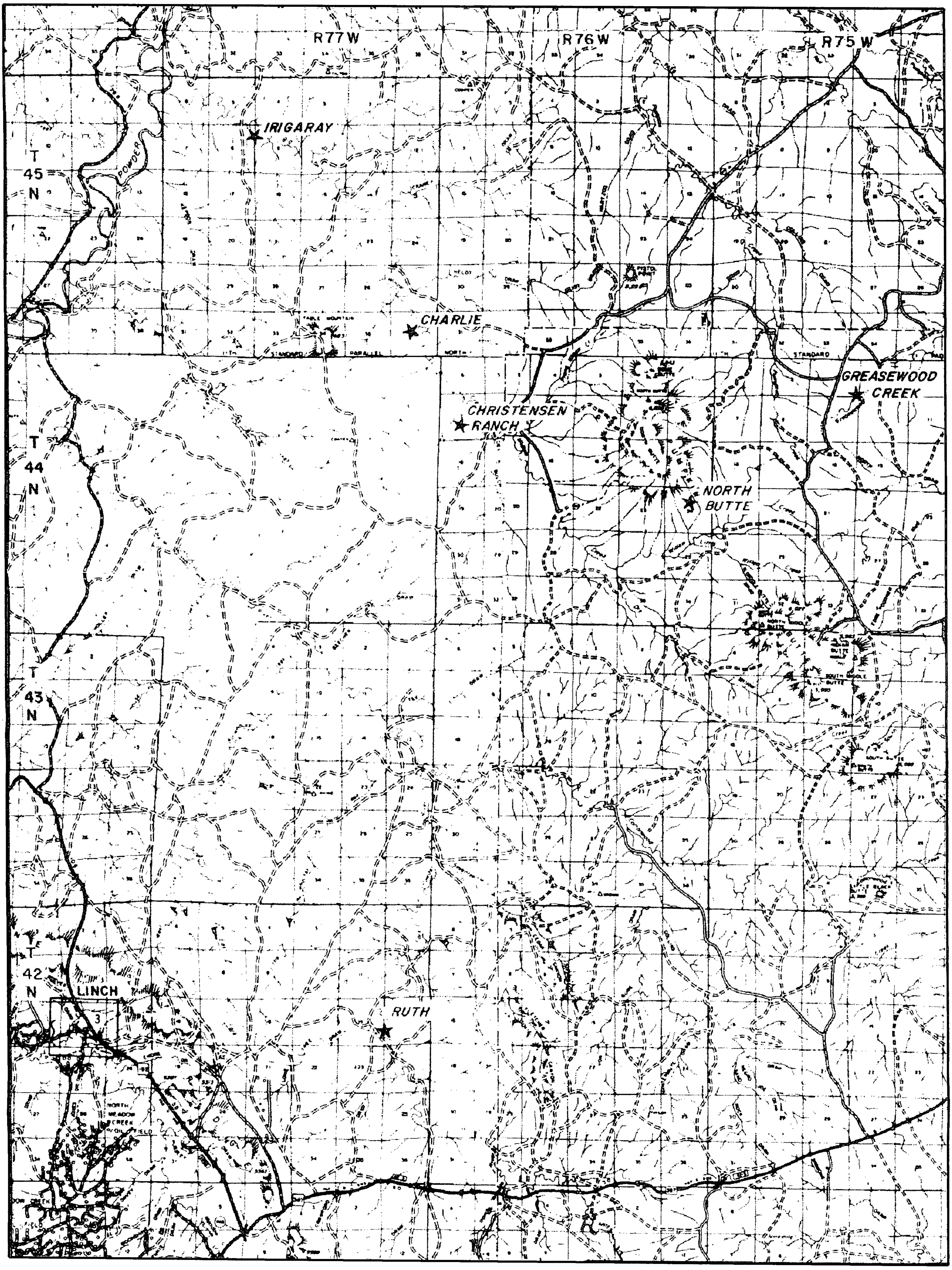
Table D8-5 Comparison of Total Vegetative Cover Data

Study/Vegetation Types	Vegetative Cover %	Bare Ground	Litter/Rock	Vegetation Litter/Rock
Ruth[1]				
Grassland	62	24	14	76
Sagebrush/Grassland	76	12	12	88
Drainage/Bottomland	89	0	11	100
N. Butte[2]				
Grassland	66	14	20	86
Sagebrush/Grassland	57	16	25	82
Drainage/Bottomland	72	8	20	92
Malapai[3]				
Grassland	61	32	7	69
Riparian	85	9	6	91
Bottomland Sage	78	11	10	88
Upland Sage/Grassland	68	21	11	79

Notes:
1. Uranerz 1980
2. Cleveland-Cliffs 1979
3. Malapai 1986

APPENDIX D8
VEGETATION INVENTORY

List of Figures



REVISIONS		
NO.	DATE	BY

GEOL. BY: DATE:
ENG. BY: DATE:
DRAFT. BY: DATE:

CAMECO

Cameco Resources
NORTH BUTTE ISR PROJECT
WDEQ PERMIT #632
Cambell Co., Wyoming

Figure D8-1
General Location Map for
Vegetation Studies

SIZE	SCALE	MAP INFORMATION	REV
11X17	1 In = 2 Miles		0

DRAWING LOCATION: L:\WYCR103 NORTH BUTTE\ACAD\NORTH BUTTE PERMIT APPLICATION\D8\WYCR103_VEGETATION STUDIES.DWG

L:\WYCR103 NORTH BUTTE\ACAD\NORTH BUTTE PERMIT APPLICATION\D8\WYCR103_VEGETATION STUDIES.dwg, FIGURE D8-1, 2/16/2011 3:14:50 PM, jbf, 11x17

APPENDIX D8
VEGETATION INVENTORY

List of Plates

The following 1 Drawing specifically referenced Appendix D8 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

D-212

APPENDIX D8
VEGETATION INVENTORY

List of Attachments

RUTH ISL PROJECT

AND

NORTH BUTTE ISL PROJECT

URANIUM SOLUTION MINE

Johnson and Campbell County, Wyoming

Volume IV

(Vegetation Supplement)

Supportive Information for

Wyoming D.E.Q. Permit to Mine Application

and

U.S.N.R.C. Source Material License Application

Casper

May 1989

URANERZ U.S.A., INC.

Draft
Vegetation Report
for the
Ruth ISL Site

Submitted to
Uranerz, USA
Casper, Wyoming

Client No. 4716

Submitted by
Denver Environmental Center
NUS Corporation
Denver, Colorado

13 November 1981

Prepared by:

Jerry L. Ruiter

T.L. Ruiter

Approved by:

A.R. Grainger
Project Manager

A.E. Hudson
Manager
Denver Environmental Center

SECTION 1.

Uranerz Ruth R & D Vegetation Report

1981

INTRODUCTION

The Uranerz Ruth ISL site consists of approximately 1,000 acres in the southeastern corner of Johnson County, Wyoming, (T42N.R77W. Sections 13, 14, 24) 18 miles northeast of Midwest. The site lies within the Grama-Needlegrass-Wheatgrass section of the Great Plains Shortgrass Prairie Province (Bailey 1978).

The site is characterized by rolling terrain with two primary water courses, Lone Tree Draw and the Dry Fork of the Powder River, dividing it. Elevations at the site range from approximately 4,800 to 4,940 feet. The area is semi-arid with an average annual precipitation of 13.2 inches recorded at Midwest. The dominant land use at present is sheep and cattle grazing.

METHODS

Study Description

Two vegetation types were sampled in the 1981 study: an upland type and a lowland type (Figure 1). The upland type (Figure 2) is the dominant vegetation type and covers all of the study site except the drainageways. The lowland type (Figure 3) is found in the drainageways. A two acre, fenced control area has been established for each type. A list of acreage by vegetation type is shown in Table 1.

TABLE I

LIST OF VEGETATION TYPES AND ACREAGES

	Acreage	
Vegetation Type	Permit Area	Control Area
Upland	(To be compiled)	2.0
Lowland	________	2.0
Total		4.0

Figure 2. Upland Vegetation Type

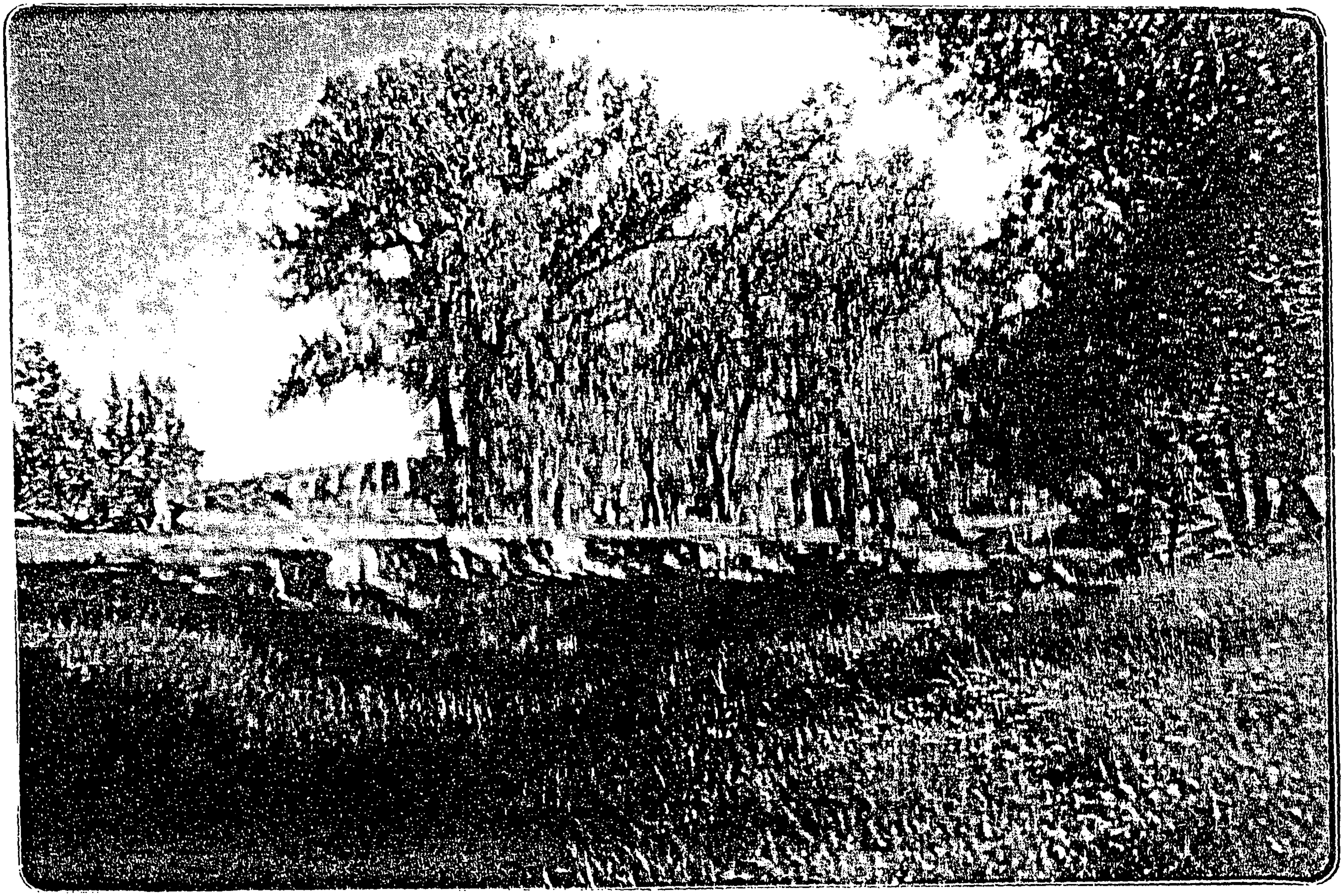


Figure 3. Lowland Vegetation Type

Because sampling occurred very late in the growing season (September), it is probable that many species which occur on the site were not observed. Several others could not be identified to species level because they were past flowering. A species list was made of plants observed on the site. Selected voucher specimens were obtained.

Sampling was conducted in accordance with Guideline No. 2 (WDEQ 1981). Cover and production methods were identical for affected and control plots.

Quadrats were randomly located on a gridded map. Grazing exclosures covering slightly more than $1 m^2$ were built of woven wire fencing and placed on the site, at the points indicated (Figure 1), in spring 1981 on both the affected and control areas. Exclosures were removed and samples were taken in the exclosure plots during the period 9-13 September 1981. All cover, production and shrub data were acquired from the same square meter quadrats.

Cover was ocularly estimated. Cover estimates were made for rock and litter, bare ground and total vegetation as well as cover by individual species. The summation of the rock and litter, bare ground and total vegetation cover values was always 100 percent. The summation of the values for individual species may exceed the total vegetation cover estimate because of overlapping vegetation layers. The values for each type of cover were then averaged by vegetation type and for the affected and control areas.

Plants were clipped to obtain production estimates. Only perennial grasses and forbs were clipped. There was some confusion concerning the status of several perennial forbs which resulted in not all of the appropriate plants being clipped. Average total production and individual species production were calculated by vegetation type and for the disturbed and affected areas.

Shrubs and subshrubs which were observed in the affected area quadrats were counted and their heights measured. Averages were made for shrub heights and density by species and total shrubs for each vegetation type. Shrub data were not taken for control areas.

Sample adequacy was determined for cover, production and shrub density parameters using the following equation (WDEQ 1981):

$$n_{min} \geq \frac{2(sz)^2}{(d\bar{x})^2}$$

where z = 1.28 and d = 0.1 for cover and production and z = 0.84 and d = 0.2 for tree and shrub density.

RESULTS

A list of species observed on the Uranerz Ruth ISL site during 9-13 September 1981 is found in Table 2. Sampling earlier in the growing season would have resulted in the observation of more forb species and the availability of more flower and seed heads for identification. No noxious weeds, selenium indicators (WDEQ 1981) or threatened or endangered species (USF&WS 1980, Clark and Dorn 1979) were observed on the study site. Data sheets are in Appendix I.

Upland Vegetation Type

The upland vegetation type was relatively dry with more than a third of the affected area (36.24 percent) bare ground. Litter and rock accounted for almost a fifth of the area (19.19 percent) and vegetation covered the remainder (44.43 percent)(Table 3). The upland vegetation type in the area to be affected by mining was found to be dominated by graminoids which make up 71 percent of the vegetation cover. The most prominent graminoid species are blue grama (Bouteloua gracilis) and needle-and-thread grass (Stipa comata). Shrubs and subshrubs contribute 17 percent of the vegetation cover with big sagebrush (Artemisia tridentata) the most conspicuous. Silver sagebrush (Artemisia cana) and fringed sagebrush (Artemisia frigida) are also common. Forbs contribute only 8 percent of the vegetation cover. The low amount of forb cover may be indicative of the late sampling. The most common forbs are plains pricklypear (Opuntia polyacantha) and Hood's phlox (Phlox hoodii). These forbs are documented as being increasers on heavily grazed range (Mueggler and Stewart 1980 and Stoddart, Smith and Box 1975). Cover by species is shown in Table 4.

The cover data for the upland control area are similar to those for the affected area. Bare ground accounts for 22.70 percent, litter and rock for 27.00 percent and vegetation for 50.30 percent (Table 3). Graminoids dominate the landscape (89 percent of the vegetation cover) with blue grama and needle-and-thread grass again the most dominant species. Shrubs are not as common as in the affected area, however, with only 4 percent of the vegetation cover. Big sage is the dominant shrub species. Forbs also contribute only 4 percent of the vegetation cover with yarrow (Achillea millefolium) being the most common species (Table4).

The production estimate for the upland affected area reflects the drier conditions found there as compared with the lowland vegetation type. Total production averages 42.19 g/m^2 (Table 5). Most of this is contributed by graminoids (Table 6).

Production on the upland control area was found to be somewhat higher than on the upland affected area. The average total production for the upland control area is 52.00 g/m^2 (Table 5). Of this, graminoids contribute the greatest share (Table 6).

Although the upland vegetation type is considered a grassland, shrubs are not uncommon. The 1981 study found an average of 22,000 shrubs and subshrubs per hectare. The most numerous species were fringed sagebrush and big sagebrush. Silver sagebrush and four-wing saltbush (Atriplex canescens) are, on the average, the tallest shrubs in the vegetation type. Table 7 provides information on the shrubs sampled in this study.

Lowland Vegetation Type

The lowland vegetation type's affected area is almost one quarter (24.18 percent) bare ground. Litter and rock cover 22.36 percent and vegetation covers 53.45 percent (Table 3). Graminoids again dominate with 62 percent of the vegetation cover. The most conspicuous graminoid is western wheatgrass (Agropyron smithii). Forbs, however, compose the next most abundant group with 23 percent of the vegetation cover. Cattail (Typha latifolia) and cocklebur (Xanthium strumarium) have the highest average cover among the forbs, although their distribution is highly clumped. Shrubs and subshrubs contribute 13 percent of the vegetation cover with silver sage and licorice (Glycyrrhiza lepidota) the most dominant. Cover by species is shown in Table 4.

The lowland vegetation type's control area has less vegetation cover (38.30 percent) and bare ground (17.60 percent) than the affected area and more litter and rock cover (44.10 percent) (Table 3). The vegetation cover is again dominated by graminoids (59 percent) but the primary species are blue grama and cheatgrass (Bromus tectorum). The next most abundant group consists of forbs (22 percent of the vegetation cover) with yellow sweetclover (Melilotus officinalis) the most conspicuous species. Shrubs contribute 18 percent of the vegetation cover with little rabbitbrush (Chrysothamnus viscidiflorus) and fringed sage the most common species. Silver sage was not observed on the control area (Tables 3 and 4).

The wetter conditions of the lowland vegetation type are emphasized in the marked increase in production for the affected area. The mean production for this area is 131.71 g/m^2 (Table 5). Of this, the largest share is contributed by graminoids (Table 6).

The production estimate for the lowland control area is less than half (49.63 g/m^2) of that for the affected area (Table 5). The majority of this is contributed by graminoids (Table 6).

The occurrence of shrubs on the lowland vegetation type is very similar to that for the upland type. Shrub density on the lowland type averages 25,000 shrubs per hectare (Table 7). Licorice is, on the average, the tallest shrub species in the vegetation type.

Sample Adequacy

The results of sample adequacy calculations are found in Table 8. Adequacy as defined by WDEQ (1981) was met in the upland vegetation type affected area for vegetation cover, total cover and shrub density. Adequacy was not met for upland affected area production or any parameter in the control areas, lowland affected area. The actual confidence level which was met is shown in Table 8 for those parameters that did not meet adequacy.

Conclusion

The total study area has been previsiously impacted by current ranching activities through grazing, but more importantly by spraying and range land development that the land owner has been conducting. The September clipping and study dates may have been influenced by the unusual weather (dry and hot) and the spraying of the sage and subsequent shrubs and forbs. The area is not in a "natural" state, but in one of range improvement, thus influencing the results of this study. Some additional data may have to be collected at the time of final site selection for future use, however, this report describes the study area conditions as of 1981.

TABLE 2

LIST OF PLANT SPECIES OBSERVED ON THE URANERZ RUTH ISL SITE SEPTEMBER 1981

Scientific Name	Common Name
Trees, Shrubs and Subshrubs	
Artemisia cana Pursh	Silver Sagebrush
Artemisia frigida Willd.	Fringed Sagebrush
Artemisia tridentata Nutt.	Big Sagebrush
Atriplex canescens (Pursh) Nutt.	Four-wing Saltbush
Ceratoides lanata (Pursh) Howell	Winterfat
Chrysothamnus viscidiflorus (Hook.) Nutt.	Little Rabbitbrush
Glycyrrhiza lepidota Pursh	Licorice
Haplopappus spinulosus (Pursh) DC.	Goldenweed
Populus deltoides Marsh.	Plains Cottonwood
Rosa sp. L.	Wild Rose
Graminoids	
Agropyron smithii Rydb.	Western Wheatgrass
Agrostis sp. L.	Bentgrass
Bouteloua gracilis (H.B.K.)	Blue Grama
Bromus japonicus Thunb.	Japanese Brome
Bromus tectorum L.	Cheatgrass
Carex filifolia Nutt.	Threadleaf Sedge
Festuca octoflora Walt.	Annual Fescue
Juncus balticus Willd.	Rush
Koeleria macrantha (Ledeb.) Schultes	Junegrass
Oryzopsis hymenoides (Roem. & Schult.)	Indian Ricegrass
Poa pratensis L.	Kentucky Bluegrass
Poa sandbergii Vasey	Sandberg Bluegrass
Polypogon monospeliensis (L.)	Rabbitfoot Grass
Scirpus sp. L.	Bulrush
Spartina pectinata Link, Jahrb.	Prairie Cordgrass
Stipa comata Trin. & Rupr.	Needle-and-thread Grass

TABLE 2 (Continued)

Scientific Name	Common Name
Graminoids (continued)	
Stipa viridula Trin.	Green Needlegrass
Forbs	
Achillea millefolium L.	Yarrow
Aster adscendens Lindl.	Aster
Aster falcatus Lindl.	Aster
Capsella bursa-pastoris (L.) Medic.	Shepherd's Purse
Chenopodium sp. L.	Lamb's Quarters
Cryptantha sp. Lehm.	Miner's Candle
Eriogonum sp. Michx.	Wild Buckwheat
Helianthus sp. L.	Sunflower
Lepidium sp. L.	Peppergrass
Lupinus sp. L.	Lupine
Lygodesmia sp. D. Don	Skeletonweed
Melilotus officinalis (L.) Pall.	Yellow Sweetclover
Opuntia polyacantha Haw.	Plains Pricklypear
Oxytropis sp. DC.	Stemless Locoweed
Penstemon sp. Mitch.	Beardtongue
Phlox hoodii Richards.	Hood's Phlox
Plantago patagonica Jacq.	Plantain
Polygonum sp. L.	Knotweed
Rudbeckia laciniata L.	Coneflower
Salsola kali L.	Russian Thistle
Solidago mollis Bartl.	Goldenrod
Sphaeralcea coccinea (Nutt.) Rydb.	Scarlet Globemallow
Sisymbrium sp. L.	Tumble Mustard
Taraxacum officinale Weber	Common Dandelion
Typha latifolia L.	Cattail
Xanthium strumarium L.	Cocklebur

Nomenclature follows Dorn (1977).

TABLE 3
SUMMARY OF COVER DATA

	Upland				Lowland			
	A		C		A		C	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Vegetation	44.43	13.20	50.30	17.68	53.45	19.27	38.30	12.45
Litter and Rock	19.19	11.20	27.00	12.63	22.36	15.27	44.10	19.17
Bare Ground	36.24	14.90	22.70	18.00	24.18	22.09	17.60	19.81
Vegetation, Litter, Rock	64.12	15.20	77.30	18.00	75.82	22.09	82.40	19.81

A = affected area

C = control area

TABLE 4

MEAN PERCENT COVER OF PLANT SPECIES ON THE URANERZ RUTH ISL SITE, SEPTEMBER 1981

Species	Upland A	Upland C	Lowland A	Lowland C
Shrubs and Subshrubs				
Artemisia cana	1.48	-	4.14	-
Artemisia frigida	1.67	0.55	0.73	2.56
Artemisia tridentata	4.55	1.40	-	-
Atriplex canescens	0.44	-	-	-
Ceratoides lanata	0.06	0.20	-	-
Chrysothamnus viscidiflorus	0.24	-	0.01	3.15
Glycyrrhiza lepidota	0.04	-	2.82	2.00
Haplopappus spinulosus	0.12	-	-	-
Rosa sp.	-	-	0.18	-
Subtotal	8.60	2.15	7.88	7.71
Graminoids				
Agropyron smithii	3.01	2.00	25.00	5.30
Agrostis sp.	-	-	2.00	-
Bouteloua gracilis	11.23	20.00	0.18	7.40
Bromus japonicus	-	0.10	-	-
Bromus tectorum	4.68	7.71	2.27	6.11
Carex filifolia	3.27	-	-	-
Festuca octoflora	0.56	0.62	-	-
Juncus balticus	-	-	0.55	0.10
Koeleria macrantha	2.16	0.16	0.36	-
Oryzopsis hymenoides	0.45	-	-	0.40
Poa sandbergii	0.24	7.01	2.92	2.81
Polypogon monospeliensis	-	-	0.55	-
Scirpus sp.	-	-	-	0.05
Spartina pectinata	-	-	1.82	0.70
Stipa comata	9.99	12.00	0.64	1.75
Subtotal	35.59	49.60	36.29	24.62

TABLE 4 (continued)

Species	Upland A	Upland C	Lowland A	Lowland C
Forbs				
Achillea millefolium	0.06	0.70	0.45	0.70
Aster adscendens	-	-	-	0.10
Aster falcatus	-	-	0.82	0.60
Capsella bursa-pastoris	0.13	-	0.18	-
Chenopodium sp.	0.05	-	1.73	0.01
Cryptantha sp.	0.25	-	-	-
Eriogonum sp.	< 0.01	-	-	-
Helianthus sp.	-	-	-	0.20
Lepidium sp.	0.27	0.21	0.74	0.22
Lupinus sp.	0.01	-	-	-
Lygodesmia sp.	0.03	-	-	-
Melilotus officinalis	0.01	-	1.55	3.75
Opuntia polyacantha	1.46	0.40	-	0.90
Oxytropis sp.	0.01	-	-	-
Penstemon sp.	0.04	-	-	-
Phlox hoodii	0.63	0.11	-	-
Plantago patagonica	0.24	0.51	-	0.10
Polygonum sp.	-	-	-	0.10
Rudbeckia laciniata	-	-	2.09	0.30
Salsola kali	0.12	-	0.01	0.50
Solidago mollis	-	-	1.00	-
Sphaeralcea coccinea	0.30	0.01	0.01	0.10
Sisymbrium sp.	0.13	-	-	-
Taraxacum officinale	-	-	0.18	0.50
Tragopogon sp.	0.01	0.10	-	0.40
Typha latifolia	-	-	2.73	-
Xanthium strumarium	-	-	2.18	-
Unknown Forbs	0.43	0.23	-	0.72
Subtotal	4.18	2.27	13.67	9.20

TABLE 4 (continued)

Species	Upland A	Upland C	Lowland A	Lowland C
Lichen	1.47	1.41	-	-
Equisetum sp.	-	-	0.73	0.25
Total Vegetation Cover	49.84	55.43	58.57	41.78

A = affected area

C = control area

TABLE 5
SUMMARY OF PRODUCTION DATA

Vegetation Type	Oven Dry Weight Production (g/m^2)			
	Affected		Control	
	$\bar{x}$	s	$\bar{x}$	s
Upland	42.06	23.8	52.00	28.9
Lowland	131.71	100.9	49.63	27.4

TABLE 6

MEAN PRODUCTION OF PLANT SPECIES (g/m^2) ON THE URANERZ RUTH ISL SITE, SEPTEMBER 1981

Species	Upland A	Upland C	Lowland A	Lowland C
Graminoids				
Agropyron smithii	7.28	2.94	81.48	12.16
Agrostis sp.	-	-	1.49	-
Bouteloua gracilis	7.65	14.77	0.12	6.88
Carex filifolia	2.30	-	-	-
Juncus balticus	-	-	2.59	0.73
Koeleria macrantha	3.09	0.24	0.95	-
Oryzopsis hymenoides	0.97	-	-	1.19
Poa sandbergii	0.32	9.43	3.66	8.12
Polypogon monospeliensis	-	-	1.59	-
Scirpus sp.	-	-	-	1.16
Spartina pectinata	-	-	5.05	4.08
Stipa comata	20.39	24.28	1.23	5.59
Subtotal	42.00	51.66	98.16	39.91
Forbs				
Achillea millefolium	0.05	0.25	0.27	0.15
Aster adscendens	-	-	-	0.42
Aster falcatus	-	-	1.77	0.52
Melilotus officinalis	0.01	-	1.95	8.06
Oxytropis sp.	< 0.01	-	-	-
Penstemon sp.	0.01	-	-	-
Rudbeckia laciniata	-	-	4.89	0.13
Solidago mollis	-	-	4.35	-
Sphaeralcea coccinea	0.08	-	-	-
Tragopogon sp.	0.02	0.08	-	0.56
Typha latifolia	-	-	14.25	-

TABLE 6 (continued)

Species	Upland A	Upland C	Lowland A	Lowland C
Xanthium strumarium	-	-	6.06	-
Unknown Forb	-	-	-	1.11
Subtotal	0.17	0.33	33.54	10.95
Total	42.17	51.99	131.70	50.86

A = affected area

C = control area

TABLE 7

SUMMARY OF SHRUB AND SUBSHRUB DATA FROM THE URANERZ RUTH ISL STUDY AREA, SEPTEMBER 1981

Vegetation Type and Species	Number Sampled	Mean Heights (cm)	Combined Shrubs/Hectare
Upland			
Artemisia cana	18	34.3	22,000
Artemisia frigida	90	20.4	
Artemisia tridentata	40	20.8	
Atriplex canescens	3	28.7	
Ceratoides lanata	2	14.0	
Chrysothamnus viscidiflorus	15	12.2	
Glycyrrhiza lepidota	1	14.0	
Haplopappus spinulosus	3	13.7	
Lowland			
Artemisia cana	18	19.7	25,000
Artemisia frigida	5	14.3	
Glycyrrhiza lepidota	4	23.0	
Rosa sp.	1	16.0	

TABLE 8

SAMPLE ADEQUACY

	$\bar{x}$	s	n	n_{min}[1]	d[2] Met
Cover					
Upland					
Affected					
Vegetation	44.43	13.2	77	29	-
Total	64.12	15.2	77	19	-
Control					
Vegetation	50.3	17.7	10	36	0.33
Total	77.3	18.0	10	18	0.25
Lowland					
Affected					
Vegetation	53.45	19.3	11	43	0.32
Total	75.82	22.1	11	28	0.28
Control					
Vegetation	38.30	12.5	10	35	0.31
Total	82.40	19.8	10	19	0.25
Production					
Upland					
Affected	42.06	23.8	77	105	0.22
Control	52.00	28.9	10	102	0.39
Lowland					
Affected	131.71	100.9	11	193	0.41
Control	49.63	27.4	10	82	0.39
Shrub Density					
Upland	2.3	2.9	77	60	-
Lowland	2.5	3.9	10	22	0.42

1 minimum sample size

2 calculated confidence level

SECTION 2.

Cleveland-Cliffs North Butte Vegetation Report

1979

VEGETATION

METHODS

The methods used were based on the Wyoming Land Quality Division Guideline No. 2, dated March 1979, and on personal discussions with the staff Plant Ecologist of the Wyoming Department of Environmental Quality.

The method used to map major vegetative cover types was to take 1978 black and white aerial photographs and delineate type boundaries for all areas covering two or more acres. These boundaries were then transferred to a topographic base map (scale 1"=600') with a Bausch and Lomb zoom transfer scope. The map was later reduced to 1"=500' to be consistent with other permit maps. Field studies verified the cover type and species present.

Methods for locatio: and construction of vegetative exclosures followed guidelines established by the Wyoming Department of Environmental Quality. A total of 153 vegetative exclosures were established by random location during April of 1979.

The process for establishing the exclosure locations entailed defining the area of interest on a topographic map (scale 1:500) and transferring the boundaries to a grid overlay (100 squares per square inch). Using a computer program for random number, an "x" and a "y" coordinate were selected; the intersection of these coordinates identified a plot. Any points which fell outside the boundary were eliminated. The grid overlay was placed on a light table and the points were transferred to the topographic map. These points were located in the field by our surveying crew. Points falling in inappropriate locations (such as in a road, old drillsite, or pond) were eliminated and a new point selected. When the plot center was reached, a pin flag was stuck in the ground and a steel fencepost was driven into the ground nearby with a numbered tag attached.

Exclosures were placed in the three major vegetative types: short grass, short grass-sagebrush, and bottomland. A two-acre control plot was established within each control area. Considerable effort was made to insure that the control areas selected were representative of the vegetative type under consideration and that the area would not be disturbed in the foreseeable future.

Exclosures were installed using galvanized wire fencing (2"x4" openings, 12-gauge wire, 48 inches high). A square plot was constructed using four triangular shaped panels which were hog ringed together to form a pyramidal exclosure around the pin flag and anchored with steel pins. The plots were 1.47m (58 inches) on a side for a total exclosed area of 2.2m^2 (23.4 ft.^{2}) Plots were constructed so as to exclude prairie dogs, rabbits, and large herbivores. The design selected was of rigid construction with a steel post placed nearby to help encourage the cattle to rub on the post instead of the exclosure.

Locations of the exclosures at the North Butte site are shown on the vegetation cover map (Figure D-8.1).

Production measurements were made in accordance with Wyoming DEQ Guideline No. 2, 1979. Annual production of plants within each exclosure were clipped in a 1 meter by 1 meter square within the center of the exclosure. Clippings were bagged by species of life form group between July 16 and August 28, oven dried for 24 hours at 105°C and weighed. Data were analyzed by species and vegetation type with summaries prepared to reflect production in pounds per acre (Tables D-8.1 and D-8.1a).

Cover measurements were made in each of the three major vegetation types: short grass, short grass-sagebrush and bottomland. Random numbers were used to determine which productivity plots would be transect starting points. The transect direction was determined by the spin of a pointer. Each transect was 50 meters longs with the first hit on vegetation, litter or rock or bare ground being recorded at each 5 meter point. Shrub height was recorded for each shrub along the transect line. Vegetation cover measurements were conducted between July 16 and August 28.

DESCRIPTION of the VEGETATION

Four vegetation types occur in the North Butte Permit Area: short grass, short grass-sagebrush, bottomland and juniper-limber pine.

The short grass-sagebrush cover type occurs in upland areas and is characterized by big sagebrush (Artemisia tridentata), and grasses including western wheatgrass (Agropyron smithii), blue grama grass (Bouteloua gracilis), green needlegrass (Stipa viridula), and prairie junegrass (Koeleria cristata). Other common species include threadleaf sedge (Curex filifolia), western yarrow (Achillia millefolium), pricklypear cactus (Opuntia polyacantha), (Phlox sp.), wolly plantain (Plantago patagonica), and fringed sagewort (Artemisia frigida). Sagebrush is a common component of this type although small areas free of shrubs are found in the permit area.

The short grass cover type is found on level to sloping upland areas and on ridges. It is characterized by the predominance of grasses, including blue grama grass, western wheatgrass, bromes, and needlegrasses. Other common species found in this type include prairie junegrass, threadleaf sedge, phlox, wooly plantain, fringed sagewort, and big sage.

The bottomland cover type is found in lowland areas along streams, washes, and flood plains. The level to sloping sites support grass and grasslike herbaceous vegetation, sagebrush and cottonwoods in scattered stands. Vegetation in this cover type is characterized primarily by grasses including western wheatgrass, meadow barley (Hordeum brachyantherum), bluegrass (Poa sp.), Timothy (Phleum pratense), and green needlegrass. Other common species include brome, western yarrow, Lupine (Lupinus sp.), prairie clover (Petalosteman sp.) scurfpea (Psoralea sp.), common dandelion (Taraxacum officinale), and cudweed sagewort (Artemisia ludoviciana). The plains cottonwood (Poplus deltoides) is often found as scattered individual trees or small stands of trees in the bottomland cover type.

The juniper-limber pine cover type is found on shallow soils of steep slopes of North Butte or on slopes of washes near the butte. This cover type is characterized by the presence of juniper (Juniperus scopolorum) and limber pine (Pinus flexilis). Acreage of the cover types is shown in Table D-8.6.

Agricultural fields are present in the Pumpkin Buttes District; however, there are no cultivated areas in the North Butte Permit Area.

Species observed on the North Butte Permit Area are listed in Table D-8.2. The species present include 26 species of grasses, 67 species of forbs, 13 species of shrubs, and 3 species of trees.

Ground cover, including vegetation, litter and rock, bare ground, and vegetation and litter and rock combined of the vegetation cover types at the North Butte site, is summarized in Table D-8.3 and D-8.3a. Vegetation cover in the shortgrass-sagebrush type was 45.6 percent and the litter and rock was 31.4 percent. In the shortgrass type, the total ground cover was 81.0 percent of which 52.1 percent was vegetation with litter and rock contributing the remainder. Vegetative cover in the bottomland was the highest of the three vegetation types with 68.2 percent. Litter and rock contributed another 26.4 percent.

Percent cover of plant species in the three vegetation types at the North Butte site is summarized in Table D-8.4. Grasses are the major part of the vegetative cover in the shortgrass and bottomland type while big sagebrush is the largest component of cover in the shortgrass-sagebrush type.

Four shrub species were encountered on transects at the North Butte site: big sagebrush (Artemisia tridentata), silver sagebrush (Artemisia cana), fringed sagewort (Artemisia frigida), and cudweed sagewort (Artemisia ludoviciana) (Table D-8.5). The average height of big sagebrush in the shortgrass-sagebrush cover type was 30.2 cm. while in the shortgrass type, the average height was somewhat less at 22.1 cm. Only one silver sagebrush was encountered on the transects. It was located in the shortgrass-sagebrush type and was 50 cm. in height. Cudweed sagewort was encountered only in the bottomland type with an average height of 17.4 cm. In the shortgrass-sagebrush type, fringed sagewort was found with an average height of 11 cm. On the control transects, big sagebrush was encountered with an average height of 34.4 cm. in the shortgrass-sagebrush, and 21.3 cm. in the shortgrass. Cudweed sagewort was found on the control transects in the bottomland with an average height of 14.6 cm. Big sagebrush and cudweed sagewort were the only shrub species encountered on transects in the control study areas.

The annual productivity for the North Butte site is summarized in Table D-8.1. Productivity is highest in the bottomland vegetation type (1445.5 lbs/acre), next highest in the shortgrass-sagebrush type (510.3 lbs/acre), and lowest in the shortgrass type (375 lbs/acre). The data for the North Butte site in Table D-8.1 are taken from a total of 198 exclosure plots which were located on the North Butte Permit Area. Out of the 198 exclosures, 45 were located in control areas.

Table D8.7 lists the proposed endangered plant species in Wyoming and plant species, designated as rare, in Campbell County. None of the proposed endangered species have been reported to be in Campbell County (Dorn, 1977).

Three species are listed as rare in Campbell County (Dorn, 1977). Alopercurus carolinianus occurs in open ares in Campbell County, usually in areas that are wet or moist. Potentialla rivalis is found in moist to wet areas on shores, in swamps, and along streambanks. Psilocarphus brevissimus occurs on plains and hills in Campbell County. No endangered or rare plant species were observed at the North Butte site during the 1979 field studies.

No designated weeds were observed at the North Butte site. It is expected that some weed species occur in the vicinity of the site.

Only one plant specie, designated as selenium indicators (Wyoming DEQ, 1978), was observed on the North Butte site: Astragalus bisulcatus.

SAMPLE ADEQUACY

Sample adequacy is shown in Table D-8.8. Sample adequacy was met for the cover measurements but not for productivity unless the entire area is used. The level of confidence achieved for productivity measurement is shown in Table D-8.9.

The raw data, in table form, for productivity, cover, and shrub height can be found on pages ____ through ____.

TABLE JE.1

Summary of Productivity Data by Vegetation Type

	Oven Dry Wt. (grams/m^2)				Oven Dry Wt. (Mean Productivity lbs/acre	
	Affected		Control			
Vegetation Type	X	S	X	S	Affected	Control
Shortgrass-Sagebrush	57.1	37.0	45.5	22.1	508.5	405.2
Shortgrass	42.4	35.2	42.8	19.2	375.8	381.2
Bottomland	162.3	80.9	92.8	61.2	1445.5	826.5

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Entire Area Productivity (Affected)

SHORTGRASS -

$$X = \frac{(1145)(42.4)}{2335}$$

$$S^2 = \left(\frac{1145}{2335}\right)^2 \left(\frac{1239.04}{32}\right)$$

$X = 20.8\ g/m^2$

$S^2 = 9.3$

BOTTOMLAND -

$$X = \frac{(58)(162.3)}{2335}$$

$$S^2 = \left(\frac{58}{2335}\right)^2 \left(\frac{6544.81}{15}\right)$$

$X = 4.0\ g/m^2$

$S^2 = 0.3$

SHORTGRASS-SAGEBRUSH -

$$X = \frac{(1132)(57.1)}{2335}$$

$$S^2 = \left(\frac{1132}{2335}\right)^2 \left(\frac{1369.0}{104}\right)$$

$X = 27.7\ g/m^2$

$S^2 = 3.1$

Entire Area Productivity (Control)

SHORTGRASS -

$$X = \frac{(1145)(42.8)}{2335}$$

$$S^2 = \left(\frac{1145}{2335}\right)^2 \left(\frac{368.64}{15}\right)$$

$X = 21.0$

$S^2 = 5.9$

BOTTOMLAND -

$$X = \frac{(58)(92.8)}{2335}$$

$$S^2 = \left(\frac{58}{2335}\right)^2 \left(\frac{3745.44}{15}\right)$$

$X = 2.3$

$S^2 = 0.2$

SHORTGRASS-SAGEBRUSH -

$$X = \frac{(1132)(45.4)}{2335}$$

$$S^2 = \left(\frac{1132}{2335}\right)^2 \left(\frac{488.41}{15}\right)$$

$X = 22.1$

$S^2 = 7.7$

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TABLE D8.1a
PRODUCTIVITY for the ENTIRE AREA

	Oven Dry Wt. (grams/m^2)				Oven Dry Wt. (lbs/acre)	
	Affected		Control		Affected	Control
	$\bar{x}$	s^2	$\bar{x}$	s^2		
Shortgrass	20.8	9.3	21.0	5.9	185.3	187.0
Shortgrass-Sagebrush	27.7	3.1	22.1	7.7	246.7	196.8
Bottomland	4.0	0.3	2.3	0.2	35.6	20.5
	$\bar{x}$	s	$\bar{x}$	s		
Entire Area	52.5	3.6	45.4	3.7	467.6	404.3

TABLE D8.2

List of Plant Species Observed on the North Butte Permit Area

SCIENTIFIC NAME	COMMON NAME
Grass or Grasslike	
Agropyron cristatum	Crested wheatgrass
Agropyron dasystachyum	Thickspike wheatgrass
Agropyron smithii	Western wheatgrass
Agropyron spicatum	Bluebunch wheatgrass
Andropogon scoparius	Little bluestem
Bromus inermis	Smooth brome grass
Bromus japonicus	Japanese brome grass
Bromus tectorum	Downy brome grass — Noxious?
Bouteloua gracilis	Blue grama grass
Calamagrostis montanensis	Plains reed grass
Calamovilfa longifolia	Prairie sandreed
Carex eleocharis	Needleleaf sedge
Carex filifolia	Threadleaf sedge
Carex sp.	Sedge
Distichlis stricta	Inland saltgrass
Elymus cinereus	Great basin wild rye
Hordeum brachyantherum	Meadow barley
Hordeum jubatom	Foxtail barley
Koeleria cristata	Prairie junegrass
Oryzopsis hymenoides	Indian ricegrass
Phleum pratense	Timothy grass
Poa fendleriana	Mutton bluegrass
Poa pratensis	Kentucky bluegrass
Secale cereale	Common rye
Stipa comata	Needle and Thread grass
Stipa viridula	Green needlegrass
Forbs	
Achillea millefolium	Western yarrow
Agoseris glauca	Pale Agoseris
Amarthus blitoides	Pigweed
Antennaria sp.	Pussy toes
Arctium minus	Common burdock
Asclepias sp.	Milkweed
Aster ericoides	Many flowered aster
Astragalus bisulcatus	Two grooved poisonvetch SI
Astragalus crassicarpus	Groundplum milkvetch
Astragalus miser	Weedy milkvetch
Calochortus gunnisonii	Mariposa lily
Cryptantha sp.	Cryptantha
Chrysopsis villosa	Hairy goldaster

List of Plant Species (Cont'd.)

SCIENTIFIC NAME	COMMON NAME
Cirsium undulatum	Wavy leaf thistle
Cirsium vulgare	Bull thistle
Cleome serrulata	Rocky mountain beeplant
Equisetum sp.	Horsetail
Erigeron strigosus	Daisy fleabane
Gaura coccinea	Scarlet guara
Glycyrrhiza lepidota	American licorice – Noxious
Grindelia squarrosa	Curlycup gumweed
Haplopappus spinulosus	Goldenweed
Helianthus annus	Common sunflower
Hyoscyamus niger	Black henbone
Kochia scoparia	Kochia
Lactuca serriola	Prickly lettuce
Lepidium densiflorum	Pepperweed
Leucocrinum montanum	Common starlily
Liatris punctata	Dotted gayfeather
Lupinus argenteus	Silvery Lupine
Lygodesmia juncea	Rush skeletonplant
Machaeranthera canescens	
Machaeranthera grindelioides	
Mammillaria vivipara	Ball cactus
Melilotus sp.	Sweet clover
Mentha arvensis	Field mint
Mertensia linearis	Bluebell
Oenothera caespitosa	Gumbo lily
Oenothera coronopifolia	Evening primrose
Opuntia polyacantha	Pricklypear cactus
Oxytropis sp.	Crazyweed
Penstemon sp.	Penstemon
Perideridia gairdneri	Yampa
Petalostemon candidus	White prairie clover
Petalostemon purpureum	Purple prairie clover
Phlox sp.	Phlox
Plantago patagonica	Wooly plantain
Plantago spinulosa	Spiny indianwheat
Polanisia trachysperma	Roughseed clammyweed
Polygonum douglasii	Douglas knotweed
Psoralea argophylla	Silverleaf scurfpea
Psoralea esculenta	Common breadroot scurfpea
Psoralea lanceolata	Lemon scurfpea
Psoralea tenuiflora	Slimflower scurfpea
Ratibida columnifera	Prairie coneflower
Rumex crispus	Curly dock
Salsola kali	Russian thistle
Solidago sparsiflora	Goldenrod
Sphaeralcea coccinea	Scarlet globemallow
Taraxacum officinale	Common dandelion
Thlaspi arvense	Fanweed
Tragopogon dubius	Salsify
Verbascum thapsus	Velvet mullein

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List of Plant Species (Cont'd.)

SCIENTIFIC NAME	COMMON NAME
Xanthium sp.	Cocklebur
Yucca glauca	Yucca
Zygadenus sp.	Deathcamas
Shrubs	
Artemisia cana	Silver sagebrush
Artemisia campestris	Wormwood sagewort
Artemisia frigida	Fringed sagewort
Artemisia ludoviciana	Cudweed sagewort
Artemisia tridentata	Big sagebrush
Atriplex conescens	Fourwing saltbush
Atriplex gordonii	Saltbush
Chrysothamnus viscidiflorus	Rubber rabbitbrush
Eurotia lanata	Winterfat
Gutierrezia sarothrae	Broom snakeweed
Prunus virginiana	Chokecherry
Rosa sp.	Wild rose
Symphoriocarpos sp.	Snowberry
Trees	
Juniperus scopulorum	Juniper
Pinus Flexilis	Limber pine
Populus deltoides	Plains cottonwood

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TABLE D-8.3

Percent Cover of the Vegetation, Litter and Rock, and Bare Ground for Vegetation Types at the North Butte Site

Vegetation Type	Vegetative Cover (%) Affected X̄	Vegetative Cover (%) Affected S	Vegetative Cover (%) Control X̄	Vegetative Cover (%) Control S	Litter and Rock (%) Affected X̄	Litter and Rock (%) Affected S	Litter and Rock (%) Control X̄	Litter and Rock (%) Control S	Bare Ground (%) Affected X̄	Bare Ground (%) Affected S	Bare Ground (%) Control X̄	Bare Ground (%) Control S	Vegetation Litter and Rock (%) Affected X̄	Vegetation Litter and Rock (%) Affected S	Vegetation Litter and Rock (%) Control X̄	Vegetation Litter and Rock (%) Control S
Shortgrass-Sagebrush	46.0	14.8	56.7	11.1	31.7	13.1	25.3	10.6	22.3	12.7	18.0	8.6	77.7	12.7	82.0	8.6
Shortgrass	54.8	11.2	58.0	11.5	26.2	12.9	26.7	13.5	18.6	11.2	15.3	9.9	81.0	11.1	84.7	9.9
Bottomland	68.5	9.0	72.0	14.7	24.6	7.8	18.0	12.1	6.9	7.5	10.0	10.7	93.1	7.5	90.0	10.7

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TABLE D-8-2a
PERCENT COVER for the ENTIRE AREA

	Vegetative Cover				Vegetation, Litter and Rock			
	Affected		Control		Affected		Control	
Vegetation Type	x	s^2	x	s^2	x	s^2	x	s^2
Shortgrass	26.9	1.0	28.4	2.1	39.7	1.0	41.5	1.6
Shortgrass-Sagebrush	22.3	0.7	27.5	1.9	37.7	0.5	39.8	1.2
Bottomland	1.7	0.005	57.7	0.009	2.3	0.003	2.2	0.005
	x	s	x	s	x	s	x	s
Entire Area	50.9	1.3	57.7	2.0	79.7	1.2	83.5	1.7

TABLE D8.4

Percent Cover of Plant Species in Three Vegetation Types
at the North Butte Site

	Bottomland		Shortgrass		Shortgrass-Sagebrush	
	Affected	Control	Affected	Control	Affected	Control
Achillea millefolium	6.2	5.3	--	--	--	--
Agropyron smithii	24.6	24.0	12.4	24.0	9.2	10.7
Artemisia ludoviciana	2.3	1.3	--	--	--	--
Artemisia tridentata	1.5	--	1.4	7.3	12.1	12.7
Astragalus sp.	3.1	0.7	--	--	--	--
Bromus sp.	2.3	4.0	1.0	1.3	2.3	--
Bouteloua gracilis	--	5.3	16.9	14.0	5.7	20.7
Calamovilfa longifolia	--	--	2.4	--	--	--
Carex sp.	0.8	0.7	4.1	--	1.6	2.7
Grindelia squarrosa	--	2.0	--	--	--	--
Koeleria cristata	--	1.3	1.0	4.0	1.4	2.0
Lichen	--	--	3.1	--	0.8	--
Lupinus sp.	3.1	6.7	0.7	--	--	--
Phleum pratense	3.1	2.7	--	--	--	--
Phlox sp.	0.8	--	0.3	--	1.4	0.7
Poa sp.	1.5	[illegible]	--	--	--	--
Psoralea sp.	2.3	2.7	--	--	0.9	--
Sphaeralcea coccinea	--	--	0.7	0.7	--	--
Stipa comata	0.8	4.7	9.0	6.7	3.8	7.3
Stipa viridula	6.2	1.3	1.7	--	1.6	--
Taraxacum officinale	1.5	0.7	--	--	--	--

TABLE D-8.5

Shrub Height for Shrub Species of the North Butte Site

Vegetation Type	Species	Shrub Height			
		Affected		Control	
		X	S	X	S
Shortgrass-Sagebrush					
	Artemisia tridentata	30.2	12.8	34.4	14.
	Artemisia frigida	11.0	1.4	--	--
	Artemisia cana	50.0	1.0	--	--
Shortgrass					
	Artemisia tridentata	22.1	6.1	21.3	7.
Bottomland					
	Artemisia tridentata	29.9	14.7	--	--
	Artemisia ludoviciana	17.4	3.7	14.6	3.

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TABLE D-8.6

VEGETATION COVER TYPES by ACREAGE and PERCENT at the
CLEVELAND CLIFFS NORTH BUTTE PERMIT AREA

Vegetation Cover Type	Acreage	% of Total
Shortgrass	1,145	48.5
Shortgrass-Sagebrush	1,132	48.0
Bottomland	58	2.5
Juniper-Limber Pine	20	0.8
Ponds	5	0.2
Total	2,360	100.0

VEGETATION COVER TYPES by ACREAGE and PERCENT at the
URANERZ NORTH BUTTE PERMIT AREA

Vegetation Cover Type	Acreage	% of Total
Grassland	342.5	34.6
Sagebrush-Grassland	614.8	62.2
Bottomland	23.6	2.4
Juniper-Sagebrush	8.1	0.8
Total	989.0	100.0

TABLE D-8.7 - PROPOSED ENDANGERED PLANT SPECIES in WYOMING[a] and RARE SPECIES in CAMPBELL COUNTY, WYOMING[b]

Family	Scientific Name	Common Name
Compositae	*Antennaria arcuata*[a]	Pussytoes
	Haplopappus contractus[a]	Goldenweed
	Porthenium ligulatum[a]	Feverfew
	Psilocarphus brevissimus[b]	
	Verbesina encelioides[b]	Crownbeard
Cruciferae	*Arabis fructicosa*[a]	Rockcress
	Lesquerella fremontii[a]	Bladder Pod
	Lesquerella macrocarpa[a]	Bladder Pod
Grimineae	*Alopecurus carolinianus*[b]	Foxtail
Leguminosae	*Astragalus proimanthus*[a]	Milkvetch
Onagraceae	*Gaura neomexicana*[a] spp. *coloradensis*	
Rosaceae	*Potentilla rivalis*[b]	Cinquefoil

a - U.S. Fish and Wildlife Service (1976)
b - Dorn (1977)

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TABLE D-8.8
SAMPLE ADEQUACY

Vegetation Type	Number of Plots Transects Sampled	Productivity ηmin	Vegetation Cover ηmin	Vegetation, Litter and Rock Cover ηmin
Shortgrass	32 Plots 29 Transects	225.8	13.7	6.2
Shortgrass-Sagebrush	104 Plots 77 Transects	137.6	33.9	8.8
Bottomland	15 Plots 11 Transects	81.4	5.7	2.1
Entire Area	151 Plots 117 Transects	1.5	1.5	0.07

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LEVEL of CONFIDENCE for PRODUCTIVITY MEASUREMENT
USING the z STATISTIC

Vegetation Type	Level of Confidence	
	Affected	Control
Shortgrass	68%	73%
Shortgrass-Sagebrush	87%	71%
Bottomland	71%	66%

SECTION 3.

Cleveland-Cliffs Greasewood Creek Vegetation Report

1980

VEGETATION INVENTORY

CLEVELAND CLIFFS IRON COMPANY

GREASEWOOD CREEK PERMIT AREA

EXECUTIVE SUMMARY

A vegetation inventory was conducted on the Cleveland Cliffs Iron Company Greasewood Creek permit area of 1828 acres during the 1980 field season. Two native vegetation types were delineated on the permit area. These types were studied to determine cover, production, and floristic composition.

Big sagebrush vegetation type occupies about 75 percent of the permit area (1364 acres). Production ranged from 490.3 to 396.0 lbs/acre. This type had total vegetative cover of 34.6 percent in most of the area and 36.5 percent in the remainder.

Silver sagebrush grassland had production values ranging from 611.9 to 559.1 lbs/acre. Total cover ranged from 35.3 to 42.0 percent on this type.

No rare, endangered, or threatened plants were detected. Two noxious weeds occur in limited (insignificant) amounts and one selenium indicator species was noted. Several winter browse species occur on the permit area.

VEGETATION INVENTORY

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LIST OF ADDENDA

SECTION D8

VEGETATION INVENTORY

D8.1 INTRODUCTION

Successful revegetation of disturbed lands comprises the final phase of the reclamation process. The basic objective for achieving adequate revegetation success is restoration of the structure and function of the ecosystem present before disturbance. Without a detailed, community-level vegetation analysis, complete restoration of the ecosystem after mining would be difficult.

Pre-mining vegetation studies are based on the investigation and description of plant communities or vegetation types that must first be recognized in the field. Although sharp boundaries are rare between any related natural phenomena, field identification of indicator life forms, species dominance and presence or absence of certain diagnostic species can be used to spatially define the plant communities under study. These parameters provide the basis for segregating and analyzing each vegetational unit which occupies the landscape.

This study is designed to provide the quantitative and taxonomic data necessary for use in achieving and evaluating final revegetation success and eventual establishment of the self-sustaining ecosystem. Methods used include photointerpretation combined with field work and laboratory analysis to map and characterize each plant community present on the study area for cover, production, and floristic composition. Other surveys undertaken during the growing season include noxious weed, selenium indicator and browse species reconnaissance.

D8.1.1 Permit Area Location

The permit area is located in the Pumpkin Buttes area of the Powder River Basin in southwestern Campbell County, Wyoming. It is located in Sections 4, 9, 10, and 15, T44N, R75W. Access is via State Highway 50 and the maintained Van Bruggen county road. The town of Savageton lies about 6 miles northeast of the lease.

D8.2 METHODS

The following methodology was implemented on the Greasewood Creek permit area which is comprised of two distinct areas; the study area and an amendment area (see Addendum D8-B, Vegetation Maps, for location of each).

D8.2.1 Vegetation Types

In this study each vegetation type or plant community is considered to comprise its own geographic or spatial area in recurring and recognizable habitats. Together, the communities within the permit area boundaries form a plant 'mosaic' requiring a detailed analysis of each contributing vegetative unit for adequate characterization.

Native vegetation types and any other physical configurations were separated by photointerpretation before analysis was undertaken. Each pretyped pattern was reevaluated and corrected, if necessary, after field inspection. Delineation of vegetation mapping units were based on floristic differences within the vegetation types present. Inclusions within a type less than three acres were not mapped.

Mapping unit delineation was followed by the drafting of the vegetation map on stable mylar, and planimetering each pattern to determine relative acreages.

Photographs were taken of each vegetation type to provide a general view of each type in the affected area and a close-up of that type for identification of major species and their growth characteristics.

D8.2.2 Sampling Procedure

D8.2.2.1 Sample Point Location

The reference (control) areas and the area to be affected by mining activities were randomly sampled by laying out two perpendicular lines, one along the south edge of the permit area or amendment area (x axis) and one along the west edge (y axis). Sampling procedure varied slightly between the affected and reference areas as described below. On the study and amendment areas (permit area), starting point locations for randomly locating sampling stations for production plots and cover transects were initially determined in the office prior to field work by establishing a grid with x and y axes of 170 units each on the study area and 50 units each on the amendment area. Random numbers were generated from a computer random numbers program. Each point which fell within the native vegetation types sampled were plotted on a map. Random numbers were generated until sufficient points were obtained for the study and amendment areas. These points were then located as close as possible in the field by reading compass bearings and pacing from a recognized landmark or previously established sample point. When it was determined after field inspection that a point was located out of the vegetation types studied, this point was abandoned and the next consecutive random point was used instead.

Reference areas (2.0 acres in size) were established for each delineated vegetation type outside the area to be affected by mining or related activities. These sites will be used for cover and production comparisons and the evaluation of precipitation effects when bond release is anticipated (Addendum D8-A, Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD) Guideline No. 2, revised March, 1979). On the reference areas the southwest corner of the site was designated the starting point with an approximate east-west line along the south edge of the reference area as the x axis and an approximate north-south line along the west edge of the area as the y axis. A set of two 2-digit numbers was taken from a table of random numbers with 99 as the greatest possible number. The field operator then paced along the y axis (north) the number indicated by the first random number, turned 90 degrees and paced in a direction parallel to the x axis the number indicated by the second random number. Cover and production data collection was initiated at the tip of the operator's boot.

Permit area exclosures erected in the spring of 1980 were constructed in the shape of a pyramid. They were approximately five feet high with a square base approximately five feet on each side. Four pieces of 48-inch high, two- by four-inch mesh, 12.5-gauge welded wire were cut for construction of the exclosure and were tied together at each corner with steel rings. Four 12-inch staples were driven in the ground at the base of each side to help hold the wire against the ground. A steel post was placed near each exclosure as a rubbing instrument so that livestock would minimize their use of the exclosure for this purpose.

Each reference area (300 x 300 feet) was established on a portion of the permit area which will not be affected by mining or related activities. Wooden post panels were constructed at each of the four corners and four-strand barbed wire was stretched across each side and secured to seventeen steel posts placed at 12-foot intervals. Barbed wire was removed after sampling so that the same management would be maintained for both the affected and control areas through the life of the mine.

Cover data were obtained from 50-meter transects and production data were extracted from a one-half meter rectangular quadrat (0.5 x 1.0 m) at each sample point in the affected and control areas.

By using the sampling procedures discussed, all of the area studied had an equal chance of being sampled. Random sampling proceeded until adequate numbers were approached in relation to established confidence intervals.

D8.2.2.2 Sampling Sequence

Data points randomly selected on the study and amendment areas were reassigned numbers according to the sequential order in which they were selected. Sampling (and subsequent sequential numbering) proceeded until the required sample adequacy was attained for each abundance measurement studied. The location of each data point and its assigned number is provided on the Vegetation Map in Addendum D8-B.

D8.2.2.3 Sampling Adequacy

The number of samples required for estimating cover and production in the affected and reference areas were determined using the formulas suggested by the WDEQ-IQD Guideline No. 2 (Addendum D8-A). Determination of the actual number of exclosures to be erected was based on past experience in vegetation types similar to those found on the permit area. Sampling data from previous studies in nearby areas were used to estimate the sample number needed in each type. Sample adequacy was calculated for all vegetation types.

D8.2.3 Cover

Cover was estimated in each native vegetation type using a 50-meter transect. One end of the transect was placed at the exclosure site and the direction of alignment was determined by taking a random compass bearing. When any part of the transect occurred out of the vegetation type studied, a new bearing was randomly selected and the transect line reestablished. Percent cover by (1) plant species and (2) total cover were both calculated. Percent cover by species was determined by recording all hits on vegetation as a pin penetrated downward through the canopy at five-meter intervals along the transect. If a pin contacted the same species more than once, only the first hit was recorded. Litter-rock and bare ground were recorded each as a first hit when contacted by the pin.

Total cover determinations were also made. This cover estimate is based on the summation of vegetative cover, litter, and bare ground and always totals 100 percent. Percent cover is derived from first hit data only and always totals 10 hits. In retrospect, when cover determinations include the understory species by summing all hits on vegetation, the result could exceed 10 hits since more than one layer may overlap the same unit of ground. In other words, ground layer species are counted as well as other species which form a canopy over the ground layer species. For the evaluation of total cover, only the percent cover of the major components (vegetation, bare ground and litter) is determined (i.e., the layer that would intercept rainfall falling perpendicular to the ground surface). The value of determining the total cover is that an estimate of bare ground susceptible to erosion is given and can be used in evaluating potential erosion of reclaimed land as compared to pre-mining conditions. These data provide one of the parameters that can be used in a soil loss equation proposed by the WDEQ-LQD (G.Beach, May 18, 1977.

Use of the Universal Soil Loss Equation to Estimate Soil Loss On Surface Mined Lands).

D8.2.4 Production

During the time period August 12 through August 27, the above-ground biomass within each quadrat was clipped by life forms (perennial grasses, grasslike species, forbs, half-shrubs, shrubs, annual grasses and annual forbs) and major species (shrubs and grasses) and placed in separate bags. Major species are defined as the two, three or more species which are dominant in the vegetation type sampled (not necessarily dominant in the quadrat). Samples were oven-dried at 80 degrees C for 24 hours, weighed and weights recorded on data sheets.

D8.2.5 Shrub Heights

Shrubs observed on cover transects were measured for height when at least one-third of the live perennial canopy occurred on a transect side. A twelve-foot retractable tape in tenths was used to determine the highest live portion of each shrub. Means and standard deviations were calculated for each type on the study and amendment areas.

D8.2.6 Other Surveys

Special reconnaissance surveys were also undertaken to note the presence of weeds, rare or endangered plants, important winter browse species, selenium indicator plants and unusual or unique physical features.

D8.2.7 Plant Identification

Plant specimens not identified in the field were collected and identified by personnel of MRC and the Rocky Mountain Herbarium on the University of Wyoming campus. Nomenclature followed the Wyoming reference collection on file in the Rocky Mountain Herbarium. A species list has been compiled and is presented in Addendum D8-F.

D8.3 RESULTS AND DISCUSSION

D8.3.1 Vegetation Types and Descriptions

Two native vegetation types were delineated for the permit area: big sagebrush and silver sagebrush grassland.

The vegetation maps in Addendum D8-B show the distribution of each type and their acreages are provided in Table D8-1.

Descriptions for the vegetation types are provided for the permit area which consists of the study area and an amendment area. However, cover and production sampling data were analyzed separately for the study and the amendment area resulting in four vegetation stratas for sampling purposes (two vegetation types in two different areas). The reason for this is that random points were chosen and exclosures erected on the original permit area (study area) before the amendment to the permit area existed. Therefore, to comply with accepted quantitative sampling standards, new random points were generated until sufficient points for cover and production analysis were established in the amendment area.

Table D8-1. Vegetation type and remaining area acreages for the permit area.

Description (Map Symbol)	PERMIT AREA Acres[1]	Percent of Total Area
Big Sagebrush (BS)	1289.5	70.5
Big Sagebrush-Amendment (BA)	74.4	4.1
Silver Sagebrush Grassland (SS)	321.4	17.6
Silver Sagebrush-Amendment (SA)	30.1	1.6
Disturbed Land (DS)[2]	112.6	6.2
TOTAL	1828.0	100.0

1 To convert to hectares, divide by 2.471.

2 Includes land disturbed for oil field activities with access roads, and stock ponds.

Approximately 75 percent of the permit area (i.e., study plus the amendment area) is in the big sagebrush vegetation type (Table D8-1). This is followed by 19 percent for silver sagebrush grassland and the remainder is disturbed land.

The vegetation types on the study area commonly occur in Wyoming and can be found in association with a variety of subdominant species. Therefore, a number of different possible understory compositions exist. The following description of the vegetation types pertain to the permit area only since differences in structural composition will occur in other areas where different environmental conditions (soil, slope, microclimates, etc.) prevail. Addendum D8-G contains photographs of vegetation types discussed. Locations of the points where photos were taken are marked on the Vegetation Inventory Map (Addendum D8-B).

D8.3.1.1 Big Sagebrush Type

Big sagebrush communities traditionally characterize most of the Powder River Basin, particularly the central and southern portions. Big sagebrush occurs in a variety of habitats and is gradually replaced by ponderosa pine types at higher elevations (mostly to the west) or the shortgrass prairie communities at lower elevations to the east.

On the permit area, the big sagebrush type ranges from dense, nearly pure stands of big sagebrush in the drainages and on north-facing slopes to low density big sagebrush stands on the ridgetops and eastern aspects. The terrain is mostly gently rolling consisting of the adjacent uplands and sideslopes above the drainages. Slopes range from 0 to 40 percent, with most of the slopes averaging 10 percent or less.

Soils within this type on the permit area are predominantly shallow to moderately deep loams. Generally, these soils are well-drained.

Dominant grass species occurring in the big sagebrush understory are blue grama (Bouteloua gracilis), needleandthread (Stipa comata), and western wheatgrass (Agropyron smithii). Big sagebrush and these three species comprise over 80 percent of the total cover and production in this vegetation type. Other common understory species include junegrass (Koeleria cristata), threadleaf sedge (Carex filifolia), hoods phlox (Phlox hoodii) and slimflower scurfpea (Psoralea tenuiflora).

D8.3.1.2 Silver Sagebrush Grassland Type

This vegetation type does not have a wide geographic range in the Powder River Basin. Its occurrence as a type is associated with alluvial fans and terraces, well-drained ephemeral water-courses and moderately sandy uplands. Density of silver sagebrush (Artemisia cana) in this type depends primarily on the amount of supplemental moisture received during a growing season, with more mesic bottomland areas usually supporting the denser silver sagebrush stands.

This type occurs predominantly in the northeast and southwest portions of the permit area. Slopes average about seven percent and range from 0 to 22 percent. Topography is generally more level than the big sagebrush type except for a few sideslopes above intermittent drainages which support moderately dense silver sagebrush stands.

Soils within this type generally resemble the soils supporting the big sagebrush type except they are deeper and more mesic. These soils are often 20 to 40 inches deep and consist of sandy loams to clay loams which are well-drained.

Silver sagebrush, needleandthread and blue grama are the most common species in this type. Other fairly common associates include Indian ricegrass (Oryzopsis hymenoides), western wheatgrass, silver scurfpea (Psoralea argophylla), scarlet gaura (Gaura coccinea), and spanish bayonet (Yucca glauca). Prairie sandreed (Calamovilfa longifolia) occurs in small pockets on drier, very sandy eastern aspects in this type.

D8.3.1.3 Disturbed Land and Reservoirs

Most of the disturbed land on the permit area exists as a result of an established oilfield. Oil well location sites, pipelines, tank batteries and pumping unit access roads comprise most of the disturbed land. All of these areas are compacted by vehicular and heavy machinery travel and are essentially void of vegetation except prostrate knotweed (Polygonum aviculare). Sparse stands of crested wheatgrass (Agropyron cristatum) are established on some of the backfilled pipeline sites and most have intermixed a few annual invaders including fireweed summercypress (Kochia scoparia) and Russian thistle (Salsola kali). Fireweed summercypress also grows on the loose subsoil around some of the pumping unit locations.

A stockpond is located in the central portion of the permit area and was about half full during field inventories. Its perimeter was mostly barren and only supported a few annual invaders including cocklebur (Xanthium strumarium). No riparian vegetation was found adjacent to the pond or anywhere else on the permit area.

D8.3.2 Cover

Two types of percent cover were determined as discussed in D8.2.3 in METHODS. The first TOTAL in Table D8-2 is for perennials only while the second TOTAL is for annuals. The GRAND TOTAL is for percent cover by life forms. The values at the bottom for litter, bare ground, and vegetation always total 100 percent. These data are used for erosion calculations as discussed earlier.

D8.3.2.1 Study Area

The silver sagebrush grassland type had the highest total cover (36.7 percent) followed by big sagebrush with 34.6 percent (Table D8-2). Control area values averaged 15 percent higher on the big sagebrush control (40.8 percent) and 12 percent higher on the silver sagebrush grassland control (40.0 percent).

Perennial cover by species on the study area was highest on the silver sagebrush grassland type (35.8 percent). Big sagebrush had perennial

TABLE D8-2. Percent cover data[1] by life forms and major ground surface classes for the vegetation types on the study area.

	VEGETATION TYPE					
	Big Sagebrush Amendment	Big Sagebrush	Big Sagebrush control	Silver Sagebrush Amendment	Silver Sagebrush Grassland	Silver Sagebrush Grassland control
Perennials						
Grasses	17.5	17.4	19.2	23.5	22.0	29.6
Grasslike	4.0	3.9	3.6	4.5	4.9	3.2
Forbs	.5	1.7	2.8	4.5	3.3	1.6
Half-shrubs	.0	.7	.8	1.0	.4	2.8
Shrubs	15.5	10.0	15.6	6.5	5.1	2.4
Succulents	.5	.0	.0	.0	.0	.0
TOTAL	38.0	33.7	42.0	40.0	35.8	39.6
Annuals						
Grasses	.0	.0	.0	.5	.0	.0
Forbs	.0	.0	.0	.0	.2	.0
TOTAL	.0	.0	.0	.5	.2	.0
Xanthoparmelia	.5	1.5	1.2	2.5	.7	.4
GRAND TOTAL	38.5	35.2	43.2	43.0	36.7	40.0
Litter	12.5	8.0	21.2	16.0	8.9	9.2
Bare ground	51.0	57.4	38.0	42.0	55.8	50.8
Vegetation	36.5	34.6	40.8	42.0	35.3	40.0

[1] Percent cover data for each life form refers to percent cover by species and are summed in the GRAND TOTAL column. The summaries of litter, bare ground, and vegetation at the bottom of the page give Total Cover (i.e., the amount that would intercept vertically falling precipitation).

cover of 33.8 percent. Both study area types were lower in perennial cover than their respective controls (20 percent lower in big sagebrush; 10 percent lower in silver sagebrush grassland). Total annual cover by species was recorded in the silver sagebrush grassland type only with a value of 0.2 percent.

Perennial grasses had the highest cover on the study area for both types sampled, averaging 17.4 percent (big sagebrush) and 22.0 percent (silver sagebrush grassland). This same condition was observed in the control areas where 19.2 percent and 29.6 percent were recorded in the big sagebrush and silver sagebrush grassland types, respectively. Grasslike species averaged 3.9 percent on big sagebrush and 4.9 percent on silver sagebrush grassland and perennial forbs on the study area ranged from 3.3 percent (silver sagebrush grassland) to 1.7 percent (big sagebrush). About 30 percent of the total half-shrub and shrub cover was recorded in the big sagebrush type with 10.7 percent. Shrubby life forms in the silver sagebrush grassland type made up less than 15 percent of the total cover with a combined average of 5.9 percent. Succulents were not recorded on the study area. Lichens (<u>Xanthoparmelia chlorochroa</u>) had cover highest in the big sagebrush type (1.5 percent) and lowest in silver sagebrush grassland (0.7 percent).

The big sagebrush type had the highest percentage of exposed bare ground averaging 57.4 percent (Table D8-3). The silver sagebrush grassland had 42 percent bare ground. The percent of ground covered by litter-rock was 12.5 percent (big sagebrush) and 16.0 percent (silver sagebrush grassland). The big sagebrush type had nearly 35 percent more exposed ground (57.4 percent) than its control (38.0 percent) and about 60 percent less litter-rock cover with affected and control area values averaging 8.0 and 21.2 percent, respectively. Exposure of bare ground was higher in the silver sagebrush grassland type (55.8 percent) than the control area for this type (50.8 percent). litter-rock cover differed slightly between the silver sagebrush grassland affected and control areas, the latter exhibiting the lowest percentage.

D8.3.2.2 Amendment Area

The silver sagebrush grassland type had the highest total cover (42.0 percent) followed by big sagebrush with 36.5 percent (Table D8-2). Control area values as compared to their respective amendment area types had cover values 10 percent higher in big sagebrush and 5 percent lower in silver sagebrush grassland.

Perennial cover by species averaged 38.0 and 40.0 percent on the big sagebrush and silver sagebrush grassland amendment areas, respectively. The control areas for these types were 10 percent higher in big sagebrush and one percent lower in silver sagebrush grassland. The silver sagebrush grassland type had total annual cover of 0.5 percent (annual forbs), and was the only type with recorded annuals on cover transects.

Perennial grasses had the highest cover values of all life forms on both types. Big sagebrush had grass cover of 17.5 percent and silver sagebrush grassland had 23.5 percent perennial grass cover. Grasslike species were 4.5 percent on silver sagebrush grassland and 4.0 percent on big sagebrush. The silver sagebrush grassland type had a higher perennial forb cover than big sagebrush, the former averaging 4.5 percent and the latter averaging 0.5 percent. Shrubs and half-shrubs comprised 40 percent of the big sagebrush cover and less than 20 percent of the cover in silver sagebrush grassland. Succulent cover averaged 0.5 percent in big sagebrush and were not recorded in silver sagebrush grassland. Lichen cover averaged 2.5 and 0.5 percent in silver sagebrush grassland and big sagebrush, respectively.

More bare ground was exposed in the big sagebrush type (51.0 percent) than the silver sagebrush type (42.0 percent) (Table D8-3). Litter-rock cover averaged 16.0 percent in silver sagebrush grassland and 12.5 percent in big sagebrush.

D8.3.2.3 Cover Summary

Cover data for 1980 showed that perennial grass was the dominant life form present for all types sampled. Shrub and half-shrub cover together was at least 15 percent higher on the big sagebrush areas than the silver sagebrush grassland areas. Most of the remaining cover for all types consisted of grasslike and perennial forb species.

Cover data (computer printouts) by life form and species for each transect are in Addendum D8-C. Tables D8-4 and D8-5 list means, standard deviations, number of samples taken and needed for vegetation and vegetation plus litter-rock, respectively.

TABLE D8-3. Summary of cover data on the study area.

		VEGETATION TYPE					
		Big Sagebrush Amendment	Big Sagebrush	Big Sagebrush control	Silver Sagebrush Amendment	Silver Sagebrush Grassland	Silver Sagebrush Grassland control
Vegetative cover (%)[1]							
	$\bar{x}$	36.5	34.6	40.8	42.0	35.3	40.0
	s	7.5	7.2	11.2	8.3	7.3	7.6
Litter & rock (%)							
	$\bar{x}$	12.5	8.0	21.2	16.0	8.9	9.2
	s	7.9	7.5	8.3	10.5	8.3	8.6
Bare ground (%)							
	$\bar{x}$	51.0	57.4	38.0	42.0	55.8	50.8
	s	7.9	7.7	11.2	12.0	11.2	10.0
Vegetation & litter-rock							
	$\bar{x}$	49.0	42.6	62.0	58.0	44.2	49.2
	s	7.9	7.7	11.2	12.0	11.2	10.0

[1] Vegetative cover is the estimate based on amount that would intercept vertically falling precipitation and is not the total of each species.

$\bar{x}$ = sample mean
s = sample standard deviation

TABLE D8-4. Means (% vegetation cover), standard deviations, number of samples taken and needed to meet suggested level of adequacy for vegetative cover studies on the study area.

Vegetative Type	$\bar{x}$	s	N	NS
Big Sagebrush Amendment	36.5	7.5	20	14
Big Sagebrush	34.6	7.2	46	15
Big Sagebrush-control	40.8	11.2	25	25
Silver Sagebrush Amendment	42.0	8.3	20	13
Silver Sagebrush Grassland	35.3	7.3	45	14
Silver Sagebrush Grassland-control	40.0	7.6	25	12

$\bar{x}$ = sample mean (vegetation cover)
s = sample standard deviation
N = number of samples taken
NS = number of samples needed for DEQ suggested sample adequacy based on vegetation

TABLE D8-5. Means (% vegetation cover plus litter-rock), standard deviations, number of samples taken and needed to meet suggested adequacy for vegetation & litter-rock cover studies on the study area.

Vegetative Type	$\bar{x}$	s	N	NS
Big Sagebrush Amendment	49.0	7.9	20	9
Big Sagebrush	42.6	7.7	46	11
Big Sagebrush-control	62.0	11.2	25	11
Silver Sagebrush Amendment	58.0	12.0	20	14
Silver Sagebrush Grassland	44.2	11.2	45	21
Silver Sagebrush Grassland-control	49.2	10.0	25	14

$\bar{x}$ = sample mean (vegetation plus litter-rock cover)
s = sample standard deviation
N = number of samples taken
NS = number of samples needed for DEQ suggested sample adequacy based on vegetation plus litter-rock

The required level of sample adequacy was attained for vegetation cover (Table D8-6) and vegetation cover plus litter-rock (Table D8-7) on all types in the study and amendment areas.

D8.3.3 Production

D8.3.3.1 Study Area

The silver sagebrush grassland type had the highest production on the study area with 611.9 lbs/acre and big sagebrush type was lowest with 490.3 lbs/acre (Table D8-8). The reverse situation existed in the control areas with the big sagebrush control exhibiting the highest value (440.4 lbs/acre) and the silver sagebrush grassland control the lowest (394.6 lbs/acre). The big sagebrush type study area production was about 10 percent higher than its control, while the silver sagebrush grassland type study area was 45 percent higher than the control area for this type.

Perennial grasses comprised the majority of the production in the study area, constituting 58 percent of silver sagebrush grassland and over 62 percent of the big sagebrush type. Production of grasslikes ranged from 46.5 lbs/acre (big sagebrush) to 52.9 lbs/acre (silver sagebrush). Perennial forb production was highest on the silver sagebrush grassland area with 94.4 lbs/acre and lowest on big sagebrush with 42.3 lbs/acre. Half-shrubs and annuals each comprised less than 10 percent of the totals for all types on the study area. Shrubs made up over 13 percent of the production on the big sagebrush type (79 lbs/acre) and about 7.0 percent of the total on the silver sagebrush grassland (43.5 lbs/acre).

TABLE D8-6. Level of vegetation[1] cover sample adequacy attained on the study area.

Vegetation Type	Affected	Control
Big Sagebrush Amendment	.917	
Big Sagebrush	.944	.901
Silver Sagebrush Amendment	.920	
Silver Sagebrush Grassland	.945	.931

[1] Using a d value of 0.1 (which represents a 10 percent reduction in percent cover) and using vegetation cover from each plot as the data points. The Wyoming DEQ suggests a minimum probability of 0.9.

TABLE D8-7. Level of vegetation[1] & litter-rock cover sample adequacy attained on the study area.

Vegetation Type	Affected	Control
Big Sagebrush Amendment	.935	
Big Sagebrush	.952	.935
Silver Sagebrush Amendment	.916	
Silver Sagebrush Grassland	.932	.927

[1] Using a d value of 0.1 (which represents a 10 percent reduction in percent cover) and using vegetation plus litter-rock cover from each plot as the data points. The Wyoming DEQ suggests a minimum probability of 0.9.

TABLE D8-8. Production data in lbs/acre by life forms on the study area.

	VEGETATION TYPE					
	Big Sagebrush Amendment	Big Sagebrush	Big Sagebrush control	Silver Sagebrush Amendment	Silver Sagebrush Grassland	Silver Sagebrush Grassland control
Perennials						
Grasses	267.0	303.2	265.2	322.6	352.3	225.8
Grasslike	18.3	46.5	38.1	68.5	52.9	60.5
Forbs	25.6	42.3	42.2	90.4	94.4	26.8
Half-shrubs	2.4	17.5	4.3	21.1	60.0	60.2
Shrubs	55.0	79.0	83.5	38.3	43.5	14.7
TOTAL	368.3	488.4	433.3	541.0	603.1	388.1
Annuals						
Grasses	26.8	.8	5.5	8.1	5.7	4.8
Forbs	.9	1.1	1.6	10.0	3.0	1.7
TOTAL	27.7	1.8	7.1	18.1	8.8	6.5
GRAND TOTAL	396.0	490.3	440.4	559.1	611.9	394.6

D8.3.3.2 Amendment Area

The silver sagebrush grassland type had the highest total production on the ammendment area with 559.1 lbs/acre (Table D8-8). Production on the big sagebrush amendment area was 396.0 lbs/acre. Control area production values for these types were 10 percent higher on big sagebrush control and nearly 30 percent lower in silver sagebrush grassland.

As in the study area, most of the production for the types in the amendment area was comprised of perennial grass with 267.0 lbs/acre (big sagebrush) and 322.6 lbs/acre (silver sagebrush grassland). Grasslike production was higher on the silver sagebrush grassland type (68.5 lbs/acre) than the big sagebrush type (18.3 lbs/acre) in the amendment area. Production of perennial forbs ranged from 25.6 lbs/acre in big sagebrush to 90.4 lbs/acre in silver sagebrush grassland. Half-shrub and annual production together comprised less than 10 percent of the total production for both types. Shrubs made up 7 percent of the silver sagebrush grassland production (38.3 lbs/acre) and about 14 percent of the big sagebrush production (55 lbs/acre).

D8.3.3.3 Production Summary

Perennial grasses comprised the majority of the production on the permit area comprising over 57 percent of the total production on all types and their controls. Grasslike, forb and shrub species made up most of the remaining production on all types.

Table D8-9 summarizes production data in lbs/acre, kg/hectare and g/m^2. Production data for each clipped quadrat are in Addendum D8-D. Means, standard deviations, number of samples taken and needed to meet WDEQ suggested sample adequacy are listed in Table D8-10.

WDEQ suggests that shrub communities (over 30 percent shrub and half-shrub cover) be sampled so that a 20 percent reduction in the mean can be detected with 80 percent confidence and that grassland communities be sampled so that a 10 percent reduction can be detected with 90 percent confidence. Sample adequacy was reached for both vegetation types (study and amendment areas) and the controls. The actual probabilities reached during sampling are summarized in Table D8-11.

D8.3.4 Shrub Heights

Height measurements were taken on 668 Artemisia tridentata individuals on the big sagebrush type. Averages ranged from 7.2 inches (big sagebrush amendment) to 9.5 inches (big sagebrush) (Tables D8-12 and D8-13). In addition, four Artemisia cana individuals measured on transects averaged 11.2 inches height. The control area for this type had Artemisia tridentata height averaging 9.3 inches (Table D8-14).

Shrub heights on the silver sagebrush grassland areas ranged between 9.0 inches (silver sagebrush grassland) to 9.5 inches (silver sagebrush

TABLE D8-9. Summary of production data on study area.

	$\bar{x}$ lbs/acre	$\bar{x}$ kg/hectare	$\bar{x}$ g/m^2	s g/m^2
Big Sagebrush Amendment	396.0	444.9	44.5	31.1
Big Sagebrush	490.3	550.9	55.1	23.8
Big Sagebrush-control	440.4	494.8	49.5	22.2
Silver Sagebrush Amendment	559.1	628.2	62.8	16.3
Silver Sagebrush Grassland	611.9	687.5	68.7	24.2
Silver Sagebrush Grassland-control	394.6	443.4	44.3	11.3

$\bar{x}$ = sample mean
s = sample standard deviation

TABLE D8-10. Means (production in g/m^2), standard deviations, number of samples taken and needed to meet suggested level of adequacy for production studies on the study area.

Vegetative Type	$\bar{x}$	s	N	NS
Big Sagebrush Amendment	44.5	31.1	19	18
Big Sagebrush	55.1	23.8	57	7
Big Sagebrush-control	49.5	22.2	31	8
Silver Sagebrush Amendment	62.8	16.3	28	23
Silver Sagebrush Grassland	68.7	24.2	65	41
Silver Sagebrush Grassland-control	44.3	11.3	40	22

$\bar{x}$ = sample mean (g/m^2)
s = sample standard deviation
N = number of samples taken
NS = number of samples needed for DEQ suggested sample adequacy based on production.

TABLE D8-11. Level of production[1] sample adequacy attained on the study area.

Vegetation Type	Affected	Control	DEQ min.
Big Sagebrush Amendment	.810		.800
Big Sagebrush	.932	.904	.800
Silver Sagebrush Amendment	.911		.900
Silver Sagebrush Grassland	.921	.927	.900

[1] Using a d value of 0.1 for grasslands and 0.2 for shrublands and using production from each plot as the data points. The Wyoming DEQ suggests a minimum probability of 0.9 for grasslands and 0.8 for shrublands.

TABLE D8-12. Summary of shrub height on study area GWCBSt.*

	N	Height $\bar{x}$	s
Artemisia cana Pursh	4	11.25"	3.93"
Artemisia tridentata Nutt. var. tridentata Nutt.	456	9.55"	4.32"

* Big sagebrush study area.

TABLE D8-13. Summary of shrub height on study area GWCBAt.*

	N	Height $\bar{x}$	s
Artemisia tridentata Nutt. var. tridentata Nutt.	212	7.24"	3.97"

*Big sagebrush amendment area.

TABLE D8-14. Summary of shrub height on study area GWCBSu.*

	N	Height $\bar{x}$	s
Artemisia tridentata Nutt. var. tridentata Nutt.	252	9.29"	4.00"

* Big sagebrush control.

grassland amendment) for Artemisia cana (Tables D8-15 and D8-16). This same species averaged 6.9 inches for the control area in this type (Table D8-17).

Shrub height data are provided in Addendum D8-E.

D8.3.5 Rare, Endangered and Threatened Plant Species

No rare plant species or those previously listed by Clark and Dorn (1979) as endangered or threatened were observed on or adjacent to the permit area during the study. Reconnaissance surveys were undertaken in spring and early and late summer.

D8.3.6 Weed Species

Two species listed as noxious weeds by the WDEQ Guideline No. 2 (revised March 1979) were found on the permit area: western ragweed (Ambrosia psilostachya), and white-leaved ragweed (Ambrosia tomentosa).

Western ragweed is common throughout the big sagebrush grassland vegetation type and occurs infrequently in the silver sagebrush grassland. Its extent is minor and consists of scattered individual plants only. No sizable, contiguous western ragweed communities occur on the permit area.

The occurrence of white-leaved ragweed was noted on a small playa located in the southeast portion of the permit area. The playa itself

TABLE D8-15. Summary of shrub height on study area GWCSSt. *

	Height		
	N	$\bar{x}$	s
Artemisia cana Pursh	459	9.05"	4.73"
Artemisia tridentata Nutt. var. tridentata Nutt.	1	4.50"	---

*Silver sagebrush grassland study area.

TABLE D8-16. Summary of shrub height on study area GWCSAt. *

	Height		
	N	$\bar{x}$	s
Artemisia cana Pursh	200	9.47"	3.68"

* Silver sagebrush grassland amendment area.

TABLE D8-17. Summary of shrub height on study area GWCSSu. *

	Height		
	N	$\bar{x}$	s
Artemisia cana Pursh	246	6.91"	2.66"
Artemisia tridentata Nutt. var. tridentata Nutt.	2	5.00"	2.12"

* Silver sagebrush grassland control.

is less than one acre in size and this species occurred throughout most of its extent.

Other species found on the permit area and listed as weeds common to Wyoming by Alley and Lee (1969) include twogrooved milkvetch (Astragalus bisulcatus), houndstongue (Cynoglossum officinale), prostrate knotweed, cocklebur, common yarrow (Achillea millefolium), dandelion (Taraxacum officinale), goldenrod (Solidago missouriensis), gumweed (Grindelia squarrosa), skeletonweed (Lygodesmia juncea), lambsquarter (Chenopodium album), fireweed summercypress, cheatgrass (Bromus tectorum), foxtail barley (Hordeum jubatum), showy milkweed (Asclepias speciosa), field pennycress (Thlaspi arvense), and tumble mustard (Sisymbrium altissimum). These species were found scattered about the area and occurred in insignificant amounts.

D8.3.7 Selenium Indicator Plant Species

One selenium indicator species, twogrooved milkvetch, occurs on the permit area. This species occurs infrequently along the sideslopes of ephemeral drainage areas and occasionally along roadsides. Occurrence on the permit area as a whole is low and its importance as an indicator species is minor.

D8.3.8 Winter Browse Species

Browse species important for livestock and wildlife during the winter period and found on the permit area include big sagebrush, silver sagebrush, winterfat (Ceratoides lanata), snowberry (Symphoricarpos occidentalis) and rubber rabbitbrush (Chrysothamnus nauseosus).

Big sagebrush has a high nutritive value at all times of the year and is moderately palatable to pronghorn, mule deer and cattle. Silver sagebrush has the same nutritive value but resinous secretions produced by the plant renders this species useful only as emergency food. Fruits remaining on the branches of snowberry during the winter period are occasionally utilized by sage grouse. The foliage and twigs are eaten extensively by deer and pronghorn. Rubber rabbitbrush and winterfat are preferred food by rabbits and hoofed browsers as winter food.

Big sagebrush and silver sagebrush are the only species which cover extensive portions of the permit area.

D8.3.9 Tree and Timber Evaluations

No timber stands of any kind occur on the permit area.

D8.4 CONCLUSIONS

Two native vegetation types in two segregated portions of the permit area were studied to determine cover, production and floristic composition. The most extensive type (big sagebrush) had cover and production values ranging between 34.6 and 36.5 percent and 396.0 to 490.3 lbs/acre, respectively. The remaining type (silver sagebrush grassland) had cover ranging between 35.5 and 42.0 percent and production ranging between 559.1 to 661.9 lbs/acre. Sampling adequacy was attained for all types and their control areas for the abundance parameters studied. Two noxious weeds occurred in limited (insignificant) amounts and one selenium indicator species was noted on the permit area.

D8.5 LIST OF REFERENCES

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D8.5.2 Plant Identification

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SECTION 4.

Cleveland-Cliffs Regional Vegetation Survey Report

1978

APPENDIX "D-8"

VEGETATION

METHODS

The original vegetative baseline study, which included the North Butte Mine Site was regional in scope.

The methods used were based on the Wyoming Land Quality Division Guideline No. 2, dated March, 1978, and on personal discussions with the staff Plant Ecologist of the Wyoming Department of Environmental Quality.

This regional concept was based on preliminary field investigation which indicated that the vegetation types in the Pumpkin Buttes District were relatively homogeneous throughout the area.

The method used to map major vegetative cover types was to take 1978 black and white aerial photographs and delineate type boundaries for all areas covering two or more acres. These boundaries were then transferred to a topographic base map (scale 1"=600') with a Baush and Lomb zoom transfer scope. The map was later reduced to 1"=500' to be consistent with other permit maps. Field studies verified the cover type and species present.

Methods for location and construction of vegetative exclosures followed guidelines established by the Wyoming Department of Environmental Quality. A total of 135 vegetative exclosures was established by random during April of 1978.

The process for establishing the exclosure locations entailed defining the areas of interest on aerial photographs (scale: 1 in=2,010') and transferring the boundaries to a grid overlay (100 squares per square inch). Using a table of random numbers, an x coordinate and a y coordinate were selected; the intersection of these coordinates identified a plot. The grid overlay was placed on the aerial photograph and the points transferred to the photograph using pins. These points were found in the field by compass and pacing. Points falling in inappropriate locations (such as in a road or pond) were eliminated and a new point selected. When the plot center was reached, a 12-inch steel stake was driven into the ground and a numbered tag attached.

Exclosures were placed in the three major vegetative types: short grass, short grass-sagebrush, and bottomland. A two-acre control plot was established for each vegetative type and 10 exclosures were randomly established within each control area. Considerable effort was made to insure that the control areas selected were representative of the vegetative type under consideration and that the area would not be disturbed in the foreseeable future.

Exclosures were installed using four steel fence posts and fencing (2- by 4-inch openings, 12-guage wire, 48-inches high), a square plot was constructed around the center stake. The plots were 1.3m (4 ft. 3 in.) on a slide for a total exclosed area of $1.7m^2$ (18.3 $ft.^2$). Plots were constructed so as to exclude prairie dogs, rabbits, and larger herbivores. The design selected was of rigid construction.

Locations of the exclosures at the North Butte site are shown on the vegetation cover map (Figure D-8.1).

Production measurements were made in accordance with Wyoming D.E.Q. Guideline No. 2, 1978. Annual production of plants within each 1.3m x 1.3m exclosure was clipped and bagged by species, major species, or life form group, minor nonshrub species, between September 2 and September 28, 1978, oven dried for 24 hours at 105^oC and weighed. Data were analyzed by species, vegetation type and summaries prepared to reflect production in pounds per acre (Tables D-8.5, D-8.8 and D-8.9).

Cover measurements were made in each of the three major vegetation types: short grass, short grass-sagebrush and bottomland. Transect starting points were located at random by means of a grid overlay to a photograph of the site and a random numbers table. An x coordinate and a y coordinate were selected from the random numbers table. The intersection of those coordinates on the grid overlay identified the location of the transect starting point. Transect direction was determined by the spin of a pointer, the starting point being a sample plot location. At each five meter point a pin was dropped perpendicular to the transect and the first hit was recorded on vegetation, rock or litter, or bare ground. Ten to thirty points were recorded along each 50 to 150 meter transect. A minimum of one transect in the cover type was sampled at each productivity plot and in some cases as many as three transects were run where the vegetation allowed. In cases where more than one transect was run, the data were averaged. Shrub height was recorded for each shrub recorded on the transect.

Vegetation cover measurements were conducted between September 5 and September 27, 1978. Plant specimens were collected between August 6 and October 6, 1978 and identifications were verified by a plant taxonomist.

DESCRIPTION of the VEGETATION

Four vegetation types occur in the Pumpkin Buttes Study Area: short grass, short grass-sagebrush, bottomland and juniper-limber pine. The same four types are on the North Butte Permit Area.

The short grass-sagebrush cover type is found in upland areas and is characterized by big sagebrush (*Artemisia tridentata*) and grasses including thickspike wheatgrass (*Agropyron dasystachyum*), blue grama grass (*Bouteloua gracilis*), Japanese brome (*Bromus japonicus*), Kentucky bluegrass (*Poa pratensis*), needle-and-thread grass (*Stipa comata*), and prairie Junegrass (*Koeleria cristata*). Other common species include bluebunch wheatgrass (*Agropyron spicatum*) and western wheatgrass (*Agropyron smithii*). Sagebrush is a common component of this type although large areas free of shrubs are found in the permit area.

The short grass cover type is found on level to sloping upland areas and on ridges. It is characterized by the predominance of grasses including blue grama grass, thickspike wheatgrass, western wheatgrass, and Japanese brome. Big sagebrush is a common component in this cover type at the North Butte Site. Other species found in this type include Kentucky bluegrass, prairie Junegrass, and needlegrasses (*Stipa* spp.).

The bottomland cover type is found in lowland areas along streams, washes and floodplains. The level to sloping alluvial sites support grass and grass-like herbaceous vegetation and sagebrush and cottonwoods in scattered stands. Vegetation in this cover type is characterized primarily by grasses including thickspike wheatgrass, western wheatgrass, Kentucky bluegrass, Japanese brome, and green needlegrass. The plains cottonwood (*Populus deltoides*) is often found as scattered individual trees or small stands of trees in the bottomland cover type.

The juniper-limber pine cover type is found primarily on shallow soils of steep slopes of the Buttes or on slopes of washes near the Buttes. This cover type is characterized by the presence of juniper (*Juniperus scopulorum*) and limber pine (*Pinus flexilis*).

Agricultural fields are present in the Pumpkin Buttes District; however, they were not sampled. There are no cultivated areas in the North Butte Permit Area.

Species observed on and in the vicinity of the North Butte Site are listed in Table D-8.1. The species present include 20 species of grasses, 65 species of forbs, 16 species of shrubs and 3 species of trees.

Ground cover, including vegetation, rock and litter of the vegetation cover types at the North Butte Site, is summarized in Table D-8.2. Vegetative cover in the short grass-sagebrush was approximately 57 percent and litter and rock cover was approximately 25 percent. In the short grass type the total ground cover was 86 percent with vegetation contributing 66 percent and litter and rock contributing the remainder. Vegetative cover in the bottomland was the highest of the three cover types with 72 percent. Litter and rock cover were about 20 percent.

Percent cover of plant species in the three vegetation types at the North Butte Site is summarized in Table D-8.3. Grasses are the major part of the vegetative cover in the short grass and bottomland type while big sagebrush is the largest component of cover in the short grass-sagebrush type.

Two shrub species were encountered on transects at the North Butte Site: big sagebrush (Artemisia tridentata) and silver sagebrush (Artemisia cana) (Table D-8.4). The average height of big sagebrush in the short grass-sagebrush cover type was 28 cm. while in the short grass type the average height was somewhat less (18 cm.). Where big sagebrush occurred in the bottomland, it averaged 51 cm. in height. Silver sage was encountered in the bottomland cover type and averaged 18 cm. in height. Big sagebrush averaged 45 cm. in height in the bottomland control transects and 24 cm. in both short grass and short grass-sagebrush control transects. Two additional shrub species were encountered on transects in the control study area (Table D-8.4).

TABLE D-8.1 - LIST of PLANT SPECIES
OBSERVED in the VICINITY of the NORTH BUTTE SITE

Scientific Name	Common Name
Grass or Grass-like:	
Agropyron cristatum	Crested wheatgrass
Agropyron dasystachyum	Thickspike wheatgrass
Agropyron smithii	Western wheatgrass
Agropyron spicatum	Bluebunch wheatgrass
Andropogon scoparius	Little bluestem
Bromus inermis	Smooth brome grass
Bromus japonicus	Japanese brome grass
Bouteloua gracilis	Blue grama grass
Calamagrostis montanensis	Reed-grass
Carex sp.	Sedge
Distichlis stricta	Saltgrass
Elymus cinereus	Great basin wild rye
Hordeum jubatum	Foxtail barley
Koeleria cristata	Prairie Junegrass
Muhlenbergia asperifolia	Muhly
Phleum pratense	Timothy grass
Poa pratensis	Kentucky bluegrass
Polypogon monspeliensis	Rabbit foot grass
Stipa comata	Needle and thread grass
Stipa viridula	Green needlegrass
Forbs:	
Achillea millefolium	Yarrow
Antennaria sp.	Pussy toes
Arenaria sp.	Sandwort
Asclepias speciosa	Milkweed
Aster adscendens	Pacific aster
Aster falcatus	Aster
Astragalus bisulcatus	Milkvetch
Astragalus missouriensis	Vetch
Astragalus purshii	Loco weed
Astragalus spatulatus	Tufted milkvetch
Camelina microcarpa	False flax
Cleome serrulata	Rocky mountain beeplant
Commandra umbellata	Bastard toad flax
Cryptantha celosioides	Miner's candle
Dalea	Prairie clover
Equiseteum arvense	Field horsetail
Eriogonum cernuum	Wild buckwheat
Gaura coccinea	Scarlet gaura
Glycyrrhiza lepidota	Wild licorice

Scientific Name	Common Name
Forbs: (Continued)	
Grindelia squarrosa	Gumweed
Haplopappus spinulosus	Goldenweed
Heterotheca villosa	Golden aster
Heuchera richardonsii	Alum root
Hymenopappus filifolium	None
Hymenoxys sp.	Actinea
Ipomopsis congesta	Trumpet gilia
Kochia scoparia	Summer cypress
Lactuca oblongifolia	Wild lettuce
Lactuca serriola	Prickly lettuce
Lappula redowski	Beggar's-tick, stickseed
Lepidium densiflorum	Peppergrass
Leptodactylon pungens	Prickly gilia
Liatris punctata	Blazing star
Lithospermum ruderale	Puccoon
Lupinus argenteus	Lupine
Lygodesmia juncea	Skeleton weed
Machaeranthena canescens	Machaeranthera
Medicago sativa	Alfalfa
Mentha arvensis	Mint
Mirabilis linearis	Umbrella wort
Navarettia breweri	Navarettia
Oenothera coronopifolia	Evening primrose
Opuntia polyacantha	Pricklypear cactus
Orobanche ludoviciana	Broom-rape
Penstemon sp.	Beardstongue
Phacelia heterophylla	Scorpion-weed
Phlox sp.	Phlox
Plantago patagonica	Wooly plantain
Polygonum douglasii	Knot weed
Psoralea argophylla	Scurf-pea
Psoralea lanceolata	Scurf-pea
Psoralea tenuiflora	Scurf-pea
Ratibida columnifera	Cone flower
Rumex crispus	Curly dock
Salsola kali	Russian thistle
Smilacina stellata	False Solomon's seal
Solanum triflorum	Cut-leaved nightshade
Solidago canadensis	Canada goldenrod
Solidago missouriensis	Smooth goldenrod
Solidago mollis	Goldenrod
Sphaeralcea coccinea	Copper mallow
Thermopsis rhombifolia	Golden banner
Tragopogon dubius	Salsify; oyster plant
Verbena bracteata	Verbena
Xanthium strumarium	Cockle-bur

TABLE D-8.1 - (Cont.)

Scientific Name	Common Name
Shrubs:	
Artemisia cana	Silver sagebrush
Artemisia frigida	Fringe sagebrush
Artemisia longifolia	Sagebrush
Artemisia ludoviciana	Prairie sagebrush
Artemisia pedatifida	Birdsfoot sagebrush
Artemisia tridentata	Big sagebrush
Atriplex canescens	Four-wing saltbush
Atriplex rosea	Saltbush
Ceratoides lanata	Winterfat
Chrysothamnus viscidiflorus	Little rabbitbrush
Gutierrezia sarothrae	Snakeweed
Ribes sp.	Currant
Rosa woodsii	Wild rose
Salix exiqua	Sandbar willow
Salix lasiandra	Willow
Symphoriocarpos oreophilus	Snowberry
Trees:	
Juniperus scopulorum	Juniper
Pinus flexilis	Limber pine
Populus deltoides	Plains cottonwood

TABLE D-
and BAR

Vegetation Type	Vegetative Cove Affected $\bar{x}$	s	Bare Ground (%) fected s	Control $\bar{x}$	s
Shortgrass-sagebrush	57	15	9	7	6
Shortgrass	66	13	12	4	6
Bottomland	72	17	18	4	6
Entire Area					

TABLE D-8.3 - PERCENT COVER of PLANT SPECIES in THREE VEGETATION TYPES at NORTH BUTTE SITE

Plant Species	Short grass	Short grass/ Sagebrush	Bottomland
Agropyron dasystachyum	12.7	12.2	11.6
Bromus japonicus	13.3	6.4	9.7
Poa pratensis	2.3	3.6	11.3
Agropyron smithii	11.3	1.1	11.3
Artemisia tridentata	3.7	13.3	7.3
Tragopogon dubius		0.7	2.0
Stipa comata	1.6	2.4	4.0
Stipa viridula		0.2	6.7
Achillea millefolium	1.3	0.7	1.7
Koeleria cristata		2.0	0.7
Plantago patagonica	0.7	0.2	0.7
Agropyron cristata			0.7
Artemisia cana			2.0
Carex sp.			2.0
Ceratoides lanata	1.0		2.0
Phlox sp.	2.0	0.2	
Bouteloua gracilis	15.0	8.5	
Lepidium densiflorum	1.0	0.2	
Liatris punctata		0.2	
Lupirus argenteus		0.2	
Chrysothamnus viscidiflorus		0.7	
Opuntia polycantha		0.2	
Agropyron spicatum		1.3	
Sphaeralcea coccinea		0.9	

TABLE D-8.4 - SHRUB HEIGHT for SHRUB SPECIES at the NORTH BUTTE SITE

Vegetation Type	Species	Shrub Height (cm)			
		Affected		Control	
		$\bar{x}$	s	$\bar{x}$	s
Shortgrass-sagebrush	*Artemisia tridentata*	28	10	24	7
	Artemisia frigida	-	-	18	6
	Artemisia cana	-	-	35	0
	Chrysothamnus viscidiflorus	-	-	13	0
Shortgrass	*Artemisia tridentata*	18	5	24	10
	Artemisia frigida	-	-	22	13
	Artemisia cana	-	-	31	50
Bottomland	*Artemisia tridentata*	51	6	45	12
	Artemisia cana	18	0	-	-

The annual productivity for the North Butte Site is summarized in Table D-8.5. Productivity is highest in the bottomland vegetation type (1250 lbs/acre), next highest in the short grass type (482 lbs/acre) and lowest in the short grass-sagebrush type (394 lbs/acre). The productivity data for the Pumpkin Buttes study area have been utilized in describing the productivity at the North Butte Site since all sampling plots are located in the general area of the Pumpkin Buttes in relatively homogeneous vegetation types. The data for the North Butte Permit Area in Table D-8.5 are taken from a total of 21 exclosure plots which were located on the North Butte Permit Area. Control plots established in the short grass-sagebrush type were inadvertently removed prior to the collection of data.

Table D-8.6 lists the proposed endangered plant species in Wyoming and plant species designated as rare in Campbell County. None of the proposed endangered species have been reported to be in Campbell County (Dorn, 1977).

Three species are listed as rare in Campbell County (Dorn, 1977). (*Alopercurus carolinianus*) occurs in open areas in Campbell County usually in areas that are wet or moist. (*Potentialla rivalis*) is found in moist to wet areas on shores, in swamps and along streambanks. (*Psilocarphus brevissimus*) occurs on plains and hills in Campbell County. No endangered or rare plant species were observed at the North Butte Site during the 1978 field studies.

No designated weeds were observed at the North Butte Site. It is expected that some weed species occur in the vicinity of the site.

Two plant species designated as selenium indicators (Wyoming D.E.Q., 1978) have been observed in the vicinity of the North Butte Site:

(*Astragalus bisulcatus*) and (*Astragalus pectinatus*). (*Astragalus bisulcatus*) was observed on the North Butte Site.

The area to be affected by mine development is located primarily in the short grass-sagebrush cover type. The short grass cover type is of limited extent in the affected area. The acreage of each vegetation type at the North Butte Permit Area is listed in Table D-8.7.

TABLE D-8.6 - SUMMARY of PRODUCTIVITY DATA by VEGETATION TYPE

Area/Vegetation Type	Oven Dry Wt. (grams/1.7m^2) Affected		Control		Oven Dry Wt. (Mean Productivity lbs/acre) Affected	Control
	$\bar{x}$	s	$\bar{x}$	s		
Pumpkin Buttes Study Area						
Shortgrass-sagebrush	75	24	-	-	394	-
Shortgrass	92	57	81	55	483	423
Bottomland	238	133	247	113	1250	1296
North Butte Permit Area						
Shortgrass-sagebrush	82	33	-	-	433	-
Shortgrass	145	94	81	55	761	423
Bottomland	185	26	247	113	969	1296

TABLE D-8.6 - PROPOSED ENDANGERED PLANT SPECIES in WYOMING[a] and RARE SPECIES in CAMPBELL COUNTY, WYOMING[b]

Family	Scientific Name	Common Name
Compositae	*Antennaria arcuata*[a]	Pussytoes
	Haplopappus contractus[a]	Goldenweed
	Porthenium ligulatum[a]	Feverfew
	Psilocarphus brevissimus[b]	
	Verbesina encelioides[b]	Crownbeard
Cruciferae	*Arabis fructicosa*[a]	Rockcress
	Lesquerella fremontii[a]	Bladder Pod
	Lesquerella macrocarpa[a]	Bladder Pod
Grimineae	*Alopecurus carolinianus*[b]	Foxtail
Leguminosae	*Astragalus proimanthus*[a]	Milkvetch
Onagraceae	*Gaura neomexicana*[a] spp. *coloradensis*	
Rosaceae	*Potentilla rivalis*[b]	Cinquefoil

a - U.S. Fish and Wildlife Service (1976)
b - Dorn (1977)

SITE SPECIFIC ADEQUACY

The regional vegetation study provided a good general description of the vegetation at the North Butte Site; however, sample adequacy was not achieved for site specific requirements because only 21 of the total 135 sample plots were actually located on the North Butte Permit Area. Table D-8.8 summarizes the cover and productivity sampling done on the site. North Butte Site production by species is given in Table D-8.9, and cover by species is given in Table D-8.10.

An additional problem encountered with the application of the regional study of the specific requirements for the North Butte Permit Area was that of control areas. Although control areas were established for the major vegetative types of the Pumpkin Buttes region, none of these were established on the North Butte Site. Therefore, the data collected from these control areas are again only a general indicator of vegetation in the vicinity and not directly applicable to the site.

The 1978 regional vegetative study did not supply adequate data for the North Butte Site; therefore, a new vegetation study to fulfill the site specific requirements at the North Butte Mine Site is being conducted during the 1979 field season. The major objective will be to collect adequate data to set a reclamation standard for the site. New sample plots for productivity measurements and more cover transects will be conducted from randomly selected points, as well as the establishment of permanent control areas on the permit area.

TABLE D-8.8 SUMMARY of COVER and PRODUCTIVITY
at the NORTH BUTTE SITE by PLOT/TRANSECT LOCATION/COVER TYPE

Plot/Transect Number	Cover Type	Total Vegetative Cover (%)	Total Vegetative Productivity (lbs/ac)
59	Short Grass	60	413
60	Short Grass-Sagebrush	80	258
61	Short Grass	70	361
62	Short Grass-Sagebrush	70	358
63	Short Grass-Sagebrush	60	181
64	Short Grass-Sagebrush	70	451
65	Bottomland	85	849
66	Short Grass-Sagebrush	50	260
67	Short Grass-Sagebrush	60	550
68	Short Grass-Sagebrush	40	642
69	Short Grass-Sagebrush	60	368
70	Short Grass	75	1,561
71	Short Grass	47	567
72	Bottomland	50	940
73	Short Grass-Sagebrush	57	689
74	Short Grass-Sagebrush	53	636
75	Short Grass-Sagebrush	77	363
76	Short Grass	80	904
103	Bottomland	60	1,194
104	Bottomland	73	988
105	Bottomland	90	872

TABLE D-8.9 MEAN VEGETATIVE PRODUCTION WITHIN
THREE VEGETATION TYPES by SPECIES at the NORTH BUTTE SITE (GMS/1.7m^2)

Species	Short grass (n=5)	Short Grass/ Sagebrush (n=11)	Bottomland (n=5)
Agropyron smithii	39.2	8.6	35.5
Agropyron dasystachyum	7.9	2.9	8.7
Mixed grasses	22.0	24.6	57.0
Bromus japonicus	38.4	9.0	0.2
Stipa comata	2.3	1.3	7.2
Poa pratensis	4.5	5.7	15.1
Mixed forbs	2.3	1.9	15.8
Achillea millefolium	0.4	0.8	9.6
Koeleria cristata	0.2	3.0	P
Lepidium densiflorum	4.0	0.2	P
Plantago patagonica	0.3	0.3	P
Tragopogon dubius	0.5	P	0.2
Bouteloua gracilis	11.0	2.8	-
Artemisia tridentata	0.2	17.6	-
Stipa viridula	-	0.2	4.0
Artemisia frigida	0.3	-	0.7
Sphaeralcea coccinia	<0.1	0.6	-
Taraxacum officinale	<0.1	-	<0.1
Grindelia squarrosa	P	-	11.0
Astragalus sp.	-	<0.1	P
Phlox sp.	P	P	-
Oryzopsis hymenoides	<0.1	P	-
Artemisia cana	-	-	14.3
Aster sp.	-	P	4.5
Lupinus argenteus	-	-	1.8
Cirsium sp.	-	-	5.2
Ceratoides lanata	3.0	-	-
Sisymbrium sp.	P	-	-
Zigadenus sp.	-	P	-
Opuntia polyacantha	-	*3	-
Psoralea sp.	-	2.3	-
Chrysothamnus viscidiflorus	-	0.3	-
Penstemon sp.	-	P	-

n = number of plots samples
P = species combined by life form for productivity determination
*3 = present but not harvested for productivity determination

TABLE D-8.10 PERCENT COVER of PLANT SPECIES
in THREE VEGETATION TYPES at the NORTH BUTTE SITE

Plant Species	Short grass	Short grass/ Sagebrush	Bottomland
Bouteloua gracilis	15.0	8.5	
Agropyron dasystachyum	12.7	12.2	11.6
Bromus japonicus	13.3	6.4	9.7
Poa pratensis	2.3	3.6	11.3
Agropyron smithii	11.3	1.1	11.3
Artemisia tridentata	3.7	13.3	7.3
Tragopogon dubius	-	0.7	2.0
Stipa comata	1.6	2.4	4.0
Stipa viridula	-	0.2	6.7
Achillea millefolium	1.3	0.7	1.7
Koeleria cristata	-	2.0	0.7
Plantago patagonica	0.7	0.2	0.7
Agropyron cristatum	-	-	0.7
Artemisia cana	-	-	2.0
Carex sp.	-	-	2.0
Ceratoides lanata	1.0	-	2.0
Phlox sp.	2.0	0.2	-
Lepidium densiflorum	1.0	0.2	-
Liatris punctata	-	0.2	-
Lupinus argenteus	-	0.2	-
Chrysothamnus viscidiflorus	-	0.7	-
Opuntia polyacantha	-	0.2	-
Agropyron spicatum	-	1.3	-
Sphaeralcea coccinea	-	0.9	-

ADDENDUM D8-1
2010 VEGETATION INVENTORY UPDATE

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ADDENDUM D8-1
2010 VEGETATION INVENTORY UPDATE

1.0 INTRODUCTION

The original vegetation sampling was conducted on the permit area in 1979 and compiled in the "Cleveland-Cliffs North Butte Vegetation Report." This was included in the **Attachment D8-1** to **Appendix D8** for the Ruth ISL Project and North Butte ISL Project, submitted by Uranerz USA, Inc. in May 1989. The mine permit was revised by Pathfinder Mines Corporation (Pathfinder) and resubmitted to Wyoming Department of Environmental Quality, Land Quality Division (DEQ, LQD) on October 1, 1992. The permit boundary of the 1992 revision by Pathfinder included an incidental boundary revision, located along the southern border of the permit area's eastern arm. It also included a proposed road access corridor, resulting in the total acreage of the permit area of 1,010 acres. The permit boundary for this 2010 update is the same as that of the approved 1992 permit with the deletion of the access road from the south. Instead the site will be accessed on existing roads.

2.0 METHODS

Cameco Resources and DEQ, LQD representatives met on May 11, 2010 to discuss the proposed permit update including vegetation sampling and reporting needs. Subsequent to that meeting, Real West Natural Resource Consulting (Real West) was contracted to update the vegetation section of the mine permit. Amber Travsky, a biologist with Real West, contacted Stacy Page with DEQ, LQD to discuss the necessary supplemental information and revisions needed to the mine permit. Based on examination of all the available permit application information, it was concluded that no additional sampling would be required for this 2010 permit update.

Revisions and supplemental information compiled by Real West for this update include:

1. Preparation of a new vegetation map.
2. Update the plant species list.
3. Identify any wetlands in the permit area.
4. Identify the potential for any threatened or endangered plant species to occur on the permit area.

Site surveys to update the plant species list, identify the potential for threatened and endangered species, and determine wetland areas (wetlands are reported in **Appendix D10**) were conducted by Real West on June 17, July 6 and 7, and August 5 and 6, 2010.

3.0 RESULTS

3.1 Plant Community Types

The North Butte permit area supports four vegetative community types including sagebrush-grassland, grassland, bottomland and juniper-sagebrush. The description of each community type is unchanged from the approved permit. Photographs of the permit area taken in 2010 are in **Figures D8-1.1** through **D8-1.7** with the photo points identified on the 2010 vegetation map (**Plate D8-1.1**).

3.2 Species List

Plant species observed on the North Butte permit area during all previous survey periods and in 2010 are listed in **Table D8-1.1**.

3.3 Cover Data

The cover and production data is unchanged from the previous approved permit. The total vegetative cover data for several studies in the region are presented in **Table D8-1.2**. The table is unchanged but the reference for the North Butte study (Study 2) is the Cleveland-Cliffs 1978 study for the Pumpkin Buttes area, rather than the 1979 study. This reference change has been made in **Table D8-1.2**.

3.4 Noxious Weeds

There are currently 25 plants listed on the Wyoming Weed and Pest Control Act Designated List (Wyoming Weed and Pest Council 2010). The species and their observed abundance on the claim site are listed in **Table D8-1.3**. Qualitative descriptor categories, as designated by the DEQ, are: very rare, rare, infrequent, abundant and very abundant. Those species listed as "very rare" were not seen on the site, but that is the lowest ranking provided by the DEQ categories.

Additional weed and pest species listed for Campbell County include the following:

- Black henbane (*Hyoscyamus niger*)
- Common cocklebur (*Xanthium strumarium*)
- Buffalobur (*Solanum rostratum*)

Of the weeds listed for Campbell County, the common cocklebur has been observed on the permit area. Also, one selenium indicator, two-grooved Milkvetch (*Astragalus bisulcatus*) was encountered.

3.5 Threatened and Endangered Species

Threatened or endangered plant species potentially occurring in Campbell County are the Ute ladies'-tresses (*Spiranthes diluvialis*) and blowout penstemon (*Penstemon haydenii*) (USFWS 2010).

3.5.1 Ute Ladies'-tresses

Ute ladies'-tresses orchid is a threatened species that occurs primarily on moist, sub-irrigated or seasonally flooded soils in valley bottoms, gravel bars, old oxbows, or floodplains bordering springs, lakes, rivers, or perennial streams at elevations between 1,780 and 6,800 feet (USFWS 1995). Suitable habitat for this species is lacking on the permit area and its presence is unlikely; therefore the proposed mining will have no effect on this species.

3.5.2 Blowout Penstemon

The sandhill region of Nebraska constitutes the largest dune field in the western hemisphere and one of the largest intact grasslands in North America. While most of the dunes are mantled with prairie vegetation, wind erosion opens up areas of bare sand called blowouts. The blowout penstemon inhabits such places, only to disappear as grasses and forbs reclaim the blowout. Once thought to occur exclusively in Nebraska, this endangered species was discovered over 180 miles away on sand dunes in central Wyoming (USFWS 1999). Suitable habitat for this species is lacking within the permit area; therefore the proposed mining operations will have no effect on this species.

4.0 LITERATURE CITED

U.S. Fish and Wildlife Service. 1995. Recommendations and Guidelines for Ute Ladies' Tresses Orchid (Spiranthes diluvialis) Recovery and Fulfilling Section 7 Consultation Responsibilities. Memo dated June 1, 1995.

U.S. Fish and Wildlife Service. 1999. U.S. Fish and Wildlife Service Announces Discovery of Endangered Plant, Blowout Penstemon, in Wyoming. Press release issued on November 1, 1999.

U.S. Fish and Wildlife Service. 2010. Threatened and Endangered Species Potentially Occurring in Campbell County, Wyoming (Web site: http://www.r6.fws.gov).

Wyoming Weed and Pest Council. 2010. WYOMING WEED & PEST CONTROL ACT DESIGNATED LIST, Designated Noxious Weeds .S. 11-5-102 (a)(xi) and Prohibited Noxious Weeds W.S. 11-12-104.

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2010 VEGETATION INVENTORY UPDATE

List of Tables

Table D8-1.1 Plant Species Observed on the North Butte Permit Area

Species	Common Name
Perennial Grasses	
Agropyron cristatum	Crested wheatgrass
Agropyron dasystachyum	Thickspike wheatgrass
Agropyron repens	Quackgrass
Agropyron riparium	Streambank wheatgrass
Agropyron smithii	Western wheatgrass
Agropyron spicatum	Bluebunch wheatgrass
Agropyron spicatum inerme	Beardless bluebunch wheatgrass
Agropyron trachyaulum	Slender wheatgrass
Agropyron longiseta	Pubescent wheatgrass
Alopecurus pratensis	Meadow foxtail
Aristida longiseta	Red three-awn
Bouteloua gracilis	Blue grama
Bromus inermis	Smooth brome
Buchloe dactyloides	Buffalograss
Calamovilfa longifolia	Prairie sandreed
Distichlis stricta	Inland saltgrass
Elymus Canadensis	Canada wildrye
Elymus ciereus	Basin wildrye
Festuca spp.	Fescue
Hordeum jubatum	Foxtail barley
Koeleria cristata	Prairie junegrass
Oryzopsis hymenoides	Indian ricegrass
Phleum pratense	Common timothy
Poa arida	Plains bluegrass
Poa canbyi	Canby bluegrass
Poa secunda	Sandberg bluegrass
Polypogon monspeliensis	Rabbitfoot grass
Sitanion hystrix	Bottlebrush squirreltail
Stipa comata	Needle-and-thread
Stipa viridula	Green needlegrass
Annual Grasses	
Bromus japonicus	Japanese brome
Bromus tectorum	Cheatgrass
Grass-like	
Carex filifolia	Threadleaf sedge
Carex spp.	Sedges
Perennial Forbs	
Abronia fragrans	Snowball sandverbena
Achillea millefolium	Common yarrow
Agoseris glauca	Pale agoseris
Allium textile	Wild onion
Ambrosia psilostachya	Cumen ragweed
Arctium minus	Burdock
Asclepias spp.	Milkweed
Asclepias speciosa	Showy milkweed
Aster adscendens	Longleaf aster
Aster falcatus	Whiteprairie aster
Astragalus bisulcatus	Twogrooved milkvetch
Astragalus geyeri	Geyer milkvetch
Astragalus spatulatus	Tufted milkvetch

Species	Common Name
Balsamorhiza sagittata	Arrowleaf balsamroot
Calochortus eurycarpus	Mariposa lily
Calochortus nuttallii	Sego lily
Camelina microcarpa	Littlepod falseflax
Casilleja sulphurea	Sulpher paintbrush
Cerastium arvense	Starry cerastium
Cirsium arvense	Canada thistle
Cirsium canescens	Thistle
Cirsium vulgare	Bull thistle
Cleome serrulata	Bee spiderflower
Cryptantha celosioides	Northern cryptantha
Cymopterus acaulis	Spring parsley
Delphinium geyeri	Geyer larkspur
Descurainia pinnata	Tansymustard
Equisetum arvense	Field horsetail
Erigeron ochroleucus	Fleabane
Eriogonum brevicaule	Wild buckwheat
Eriogonum ovalifolium	Cushion eriogonum
Gaura coccinea	Scarlet gaura
Glycyrrhiza lepidota	American licorice
Grindelia squarrosa	Curlycup gumweed
Haplopappus grendeloides	Goldenweed
Helianthus annus	Common sunflower
Heterotheca villosa	Hairy goldenaster
Lepidium densiflorum	Prairie pepperweed
Lesquerella ludoviciana	Silver bladderpod
Lithospermum incisum	Narrowleaf gromwell
Lupinus argenteus	Silvery lupine
Lygodesmia juncea	Rush skeletonplant
Machaeranthera canescens	Hoary aster
Melilotus alba	White sweetclover
Melilotus officinalis	Yellow sweetclover
Mentha arvensis	Field mint
Mertensiz linearis	Bluebell
Oenothera coronopifolia	Evening primrose
Orenothera caespitosa	Gumbo lily
Oroganche fasciulata	Broomrape
Oxytropis lagopus	Locoweed
Penstemon angustifolia	Narrowleaf penstemon
Petalostemon occidentale	Prairie clove
Phlox hoodii	Hood's phlox
Phlox longifolia	Long-leaved phlox
Plantago patagonica	Woolly plantain
Plantago spinulosa	Spiny Indianwheat
Psoralea esculenta	Breadroot scurfpea
Psoralea lanceolata	Lemon scurfpea
Psoralea tenuiflora	Slimflower scurfpea
Ranunculus spp.	Buttercup
Ratibida columnifera	Coneflower
Rumex crispus	Curly dock
Salsola kali	Russian thistle
Sisymbrium altissimum	Tumbling hedgemustard
Sisymbrium linifolium	Tumblemustard

Species	Common Name
Sphaeralcea coccinea	Scarlet globemallow
Taraxacum officinale	Dandelion
Thermopsis lanceolata	Golden banner
Tragopogon dubius	Salsify
Vicia americana	American vetch
Zigadenus venenosus	Meadow deathcamus
Annual Forbs	
Alyssum desertorum	Desert madwort
Chenopodium album	Lambsquarter goosefoot
Kochia scoparia	Kochia
Thlaspi arvense	Field pennycress
Xanthium strumarium	Cocklebur
Succulents	
Opuntia polyacantha	Prickly pear cactus
Mammillaria vivipara	Ball cactus
Sub Shrubs	
Artemisia frigida	Fringed sagebrush
Artemisia ludoviciana	White sagebrush
Artemisia pedatifida	Birdfoot sagewort
Ceratoides lanata	Common winterfat
Gutierrezia sarothrae	Broom snakeweed
Rosa woodsii	Wood's rose
Shrubs	
Artemisia cana	Silver sagebrush
Artemisia tridentata	Big sagebrush
Atriplex canescens	Fourwing saltbrush
Chrysothmnus nauseosus	Rubber rabbitbrush
Chrysothamnus vicidiflorus	Douglas rabbitbrush
Juniperus scopulorum	Juniper
Prunus virginiana	Chokecherry
Symphoricarpos occidentalis	Snowberry
Yucca glauca	Soapweed yucca
Trees	
Populus deltoides	Eastern cottonwood
Pinus flexilus	Limber pine
Bryophytes	
Lichen spp.	Lichen

Table D8-1.2 Comparison of Total Vegetative Cover Data

Study/Vegetation Types	Vegetative Cover %	Bare Ground	Litter/Rock	Vegetation Litter/Rock
Ruth[1]				
Grassland	62	24	14	76
Sagebrush/Grassland	76	12	12	88
Drainage/Bottomland	89	0	11	100
N. Butte[2]				
Grassland	66	14	20	86
Sagebrush/Grassland	57	16	25	82
Drainage/Bottomland	72	8	20	92
Malapai[3]				
Grassland	61	32	7	69
Riparian	85	9	6	91
Bottomland Sage	78	11	10	88
Upland Sage/Grassland	68	21	11	79

Notes:
1. Uranerz 1980
2. Cleveland-Cliffs 1978
3. Malapai 1986

Table D8-1.3 Noxious Weed List for the State of Wyoming and their Observed Occurrence on the North Butte Permit Area

Scientific Name	Common Name	Occurrence
Convolvulus arvensis	Field bindweed	Very rare
Cirsium arvense	Canada thistle	Rare
Euphorbia esula	Leafy spurge	Very rare
Sonchus arvensis	Perennial sowthistle	Very rare
Agropyron repens	Quackgrass	Rare
Cardaria draba	Hoary cress	Very rare
Lepidium latifolium	Perennial pepperweed	Very rare
Chrysanthemum leucanthemum	Ox-eye daisy	Very rare
Franseria discolor	Skeletonleaf bursage	Very rare
Centaurea repens	Russian knapweed	Very rare
Linaria vulgaris	Yellow toadflax	Very rare
Linaria dalmatica	Dalmatian toadflax	Very rare
Onopordum acanthium	Scotch thistle	Very rare
Carduus nutant	Musk thistle	Very rare
Arctium minus	Common burdock	Rare
Carduus acanthoides	Plumeless Thistle	Very rare
Isatis tinctoria	Dyers Woad	Very rare
Cynoglossum officinale	Houndstongue	Very rare
Centaurea maculosa	Spotted knapweed	Very rare
Centaurea diffusa	Diffuse knapweed	Very rare
Lythrum salicaria	Purple loosestrife	Very rare
Tamarix spp.	Saltcedar	Very rare
Hypericum perforatum	Common St. Johnswort	Very rare
Tanacetum vulgare	Common Tansy	Very rare
Elaeagnus augistifolium	Russian Olive	Very rare

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Figure D8-1.1

Photo point #1 looking to the west

Figure D8-1.2

Photo point #2 in the northwest corner of the permit area, below North Butte

Figure D8-1.3

Photo point #3 near the center of the permit area, looking west

Figure D8-1.4

Photo point #4 taken at the same point as #3 but looking north

Figure D8-1.5

Photo point #5, along the north central permit boundary, looking east

Figure D8-1.6

Photo point #6 along the north central permit boundary, looking east

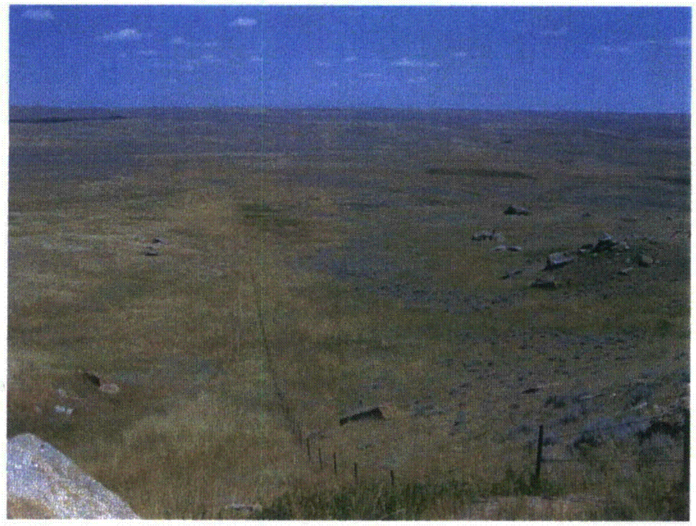

Figure D8-1.7

Photo point #7 along northwest boundary looking east

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The following 1 Drawing specifically referenced Appendix D8 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

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APPENDIX D9
WILDLIFE

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Please note: All tables, plates and attachments are located behind the tabs following this Appendix.

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APPENDIX D-9
WILDLIFE

1.0 INTRODUCTION

Uranerz prepared the original **Appendix D9** presented in its entirety in this section. Power Resources, Inc. doing business as Cameco Resources (CR) has updated this section in response to comments received from the Wyoming Department of Environmental Quality (DEQ), Land Quality Division (LQD). A Wildlife Monitoring Plan is presented in **Addendum D9-1**.

Baseline wildlife studies for Cameco Resources (CR) North Butte ISL project were initiated in the fall of 1987 by Applied ECOsystems. Data collected by Bio/West in 1978-1979 was also used as supplemental information. The North Butte permit area encompasses approximately 1039 acres situated in southwestern Campbell County, Wyoming. The elevation (4,900 to 5,700 feet) and topography of the permit area are generally typical of the rolling plains to the east and northeast of the continental divide in Wyoming. The major features in the vicinity of the permit area are prominent mesas called the Pumpkin Buttes that rise to about 6,050 feet in elevation. Surficial drainage networks coming off the permit area exhibit normally intermittent flows that are part of the headwater system of the north-flowing Powder River. Field investigations of big game, mammalian predators, small and medium sized mammals, raptors, game birds, passerine birds, herptiles, and threatened and endangered species were conducted on the permit area and adjacent habitats.

In October, 1992, Pathfinder incorporated into the permit boundary approximately 50 acres of adjacent lands, located along the southern border of the permit area's eastern arm. No additional wildlife data was collected for these lands as the previous surveys covered the permit area plus one-half to one mile, thus including these lands. Annual wildlife surveys conducted in 1992 reconfirmed that no sage grouse leks or raptor nests are present on the lands.

2.0 METHODS

Particular attention was given to important wildlife species and their habitats. For purposes of this study, important wildlife habitat was classed into two categories: habitat critical to the support of important wildlife species (e.g. threatened or endangered animals, animals protected by state or federal law, game species) and habitat offering environmental situations that add diversity to the region (e.g. streams, trees).

Personnel from Applied ECOsystems responsible for collecting field data during wildlife surveys were Gary Saunders and Timothy Lane. Mr. K. Gary Somerville provided quality assurance. Dates of wildlife observations are provided in **Table D9-1** and survey routes are shown on the Wildlife Observation Map, **Plate D9-1**. All surveys were done under favorable field conditions.

Since many of the important wildlife species are mobile (e.g. raptors, pronghorn, deer), the proposed project could affect animals that also occur in habitat adjacent to the areas to be mined. Therefore, certain wildlife studies were conducted in areas adjacent to the permit area. Scientific names of wildlife which were observed or are likely to occur on the permit area are listed in **Tables D9-1, D9-2 and D9-3**.

2.1 Site Reconnaissance

A thorough vehicle and foot reconnaissance of the study area was conducted in the fall of 1987 and spring of 1988. The purpose of the field reconnaissance was to:

Determine the habitat types in the area.

Identify and map areas that could be important to wildlife (e.g. potential raptor nest sites, sage grouse leks) so that these sites could be closely monitored during baseline study.

During a meeting with DEQ-LQD it was determined that the permit area should have a one (1) mile buffer zone for raptors and one-half mile zone for sage grouse. This study area can be characterized by four primary vegetative types.

1. Grassland with low sagebrush density – Much of the upland areas east and north of the permit area were classified as this habitat type. The topography of the area covered by this type can be generally characterized as a gently rolling plain.
2. Grassland with high sagebrush density - This type covers much of the permit area.
3. North Butte - This classification includes the base, slopes, rimrock and rocky outcrops. Sagebrush-juniper habitat is found along the base and sides of the butte. Topographically, the area covered by this habitat type consists of steep-banked ridges and draws. Limber pine-juniper habitat is located in scattered pockets below the top of North Butte on steep slopes. The rimrock encompasses the top of North Butte and consists of nearly vertical walls of sandstone that have been extensively weathered.
4. Cottonwoods - This habitat type is located along the Willow Creek drainage.

2.2 Survey of Existing Information

Compilation of existing information on wildlife resources was one of the initial tasks, which continued throughout the project as new sources were identified and additional data became available. Information on wildlife in the North Butte study area was solicited from the Wyoming Game and Fish Department, Bureau of Land Management, and ranchers in the project area and from records acquired by Uranerz from the previous mineral rights owner.

Existing information was reviewed for its relevance in describing baseline wildlife conditions for the project area. All pertinent wildlife data were used to supplement observations and data gathered on site during the course of the field program.

2.3 Big Game

Big game surveys for the North Butte project were conducted throughout the winter, spring and summer of 1988. In addition to specific surveys for big game, big game were opportunistically surveyed in conjunction with other field activities on the project area.

During surveys, one or two observers traversed the study area by vehicle and on foot and recorded all big game observed. Surveys were conducted throughout the daylight hours as well as early morning and late in the evening when the animals are more active and more likely to be observed. The topography of the study area afforded views of both large areas and relatively limited views of small areas.

2.4 Medium-Sized and Small Mammals and Predators

A list of medium-sized and small mammals and predators found in habitats similar to those on the permit area was developed based on literature and existing information from a 1978-1979 survey. Presence of the animals on site was documented through observation of the animal or characteristic sign such as tracks, scat, burrows and skeletons. Burrows and dens observed on site were examined to determine the species that constructed them.

2.5 Avifauna

Studies conducted to determine the presence, habitat association and production of avifauna on the North Butte project area focused on raptors, sage grouse, passerine and other bird species. In addition to specific surveys discussed below, opportunistic sightings of raptors, sage grouse, and other birds were recorded during field activities. Avifauna nomenclature conforms to <u>The Checklist of North American Birds</u> (AOU 1957) and subsequent revisions (AOU 1973, AOU 1976).

2.6 Raptors

Potential raptor nesting sites such as cottonwood trees, North Butte, or other areas where raptors were frequently observed within the study area were identified and mapped during all field activities and a specific raptor nest search was conducted during the spring of 1988. Two survey methods were used during the raptor nest search. The skyline watch was used to survey potential raptor nesting on and near the permit area. Adult raptors will leave the nest site to forage at least once, and often several times, each day during the time when they have young. Raptors nesting in the area would, therefore, be observed flying to forage and back to the nest during skyline watches that last several hours. The study area was also searched by vehicle and on foot during the raptor nest survey. A biologist identified potential nest sites such as cottonwood trees or the rimrock on North Butte and intensively searched for raptors, nests, and sign such as whitewash from excrement. On-foot searches were concentrated on the permit area and areas adjacent to the permit area. Raptor winter use was surveyed during January 1988 and during winter big game surveys. The dates of raptor nest searches and visitations were as follows:

01/19/88	03/31/88	05/26/88
02/26/88	04/07/88	06/07/88
03/09/88	04/13/88	06/13/88
03/18/88	04/20/88	06/14/88
03/22/88	04/25/88	06/21/88
03/24/88	05/05/88	
03/28/88	05/13/88	

2.7 Sage Grouse

A sage grouse lek search was conducted during March and April 1988. During the survey biologists searched for leks on the study area from various vantage points and by driving through the study area. The survey was conducted at dawn when biologists searched for grouse with the aid of 7-power binoculars and listened for the characteristic sounds made by strutting males.

2.8 Passerine and Other Birds

No special surveys were conducted for passerine and other birds. However, all species observed on the study area were recorded.

2.9 Herpetofauna

Surveys for reptiles and amphibians on the North Butte study area were conducted in conjunction with all field activities. A list of species found in habitats similar to those on the permit area was developed based on literature and existing information.

2.10 Threatened and Endangered Species

During all field activities on the North Butte study area, particular attention was given to document the status of species protected by the Endangered Species Act of 1973 (16 USC 1531). The area lies within the range of three endangered species: Bald eagle (Haliaeetus leucocephalus), Peregrine falcon (Falco Peregrinus anatum), and the black-footed ferret (Mustela nigripes). Habitat and presence of Bald eagles and Peregrine falcons were evaluated in conjunction with studies for other raptors as discussed in Section 2.6.

2.11 Fisheries and Aquatics

No studies were conducted on fisheries or aquatic resources because there is no suitable habitat within the permit area.

3.0 RESULTS AND DISCUSSION

3.1 Big Game

Pronghorn and mule deer were the only big game species observed on the study area during baseline investigations.

During winter surveys all pronghorn sightings took place north and east of the North Butte permit area, primarily adjacent to the county road 1 1/4 miles east of the permit area. The pronghorn were observed in this area in groups ranging in size from 4 to 56 individuals. As the weather improved during spring, these groups began to breakup and disperse. During the spring, summer and fall, relatively few pronghorn were actually observed on the permit area proper. During this time they were most frequently observed on the eastern third of the permit area and in the 1/2 mile perimeter area to the north and east of the permit area.

Although the Wyoming Game and Fish classifies the study area as winter/yearlong range, pronghorn appear to favor areas outside of the study area during the winter. During other seasons of the year, they make use of habitat within the study area. Two production counts were conducted prior to the hunting season on the study area. These counts yielded ratios of approximately 77 fawns:100 doe and 25 bucks:100 doe. Due to the small size of the study area and the small sample size, these ratios could be highly variable. Also, the highly mobile pronghorn moves freely throughout the study area and adjacent lands and the occurrence of a few additional animals on the study area when the count is conducted can greatly affect the ratios. One post hunt count was conducted which yielded a fawn:100 doe ratio of 57 and a buck:100 doe ratio of 15.

Mule deer were observed on the study area throughout the year. All mule deer sightings were on North Butte and its flanks, along unnamed drainages leading away from the Butte and along the Willow Creek drainage to the south of the permit area. North Butte, the rough and broken terrain around the butte and drainages in the area, appear to fulfill requirements as both winter and summer range for mule deer in the study area.

Two pre-hunt production counts yielded a fawn:100 doe ratio of 63 and a buck:100 doe ratio of 16. One post hunt survey yielded ratios of 58 fawns:100 doe and 25 bucks:100 doe. As with the pronghorn count, these figures could be highly variable due to the small sample size and study area. Also, mule deer are not as visible as pronghorn due to the rough, broken terrain where they were most often observed. Consultation with Mr. Harry Harju, WGFD did not reveal the presence of any big game migration corridors or critical habitats.

Big game and other wildlife observations showing group consistency, location, habitat type and activity are presented in **Attachment D9-1** using Wyoming Game and Fish Department Wildlife Observation forms and associated copies.

Pronghorn and mule deer observations are shown on **Plate D9-1**.

3.2 Medium-Sized and Small Mammals and Predators

A list of mammals whose range and habitat requirements coincide with the North Butte study area is presented in **Table D9-1**. Those species documented on the study area are also identified in the table.

No active prairie dog colonies are located on or within one-half mile of the North Butte permit area. Two old prairie dog colonies (**Plate D9-1**) located near the permit area were poisoned in the late 1970's and have not been re-established.

During morning and evening hours, coyote, red fox and badgers were observed in the study area vicinity. Also, one striped skunk was observed near ranch buildings at the Pfister Place. While these species were rarely seen, they are believed to be common in the Pumpkin Buttes vicinity.

White-tailed jackrabbits were common throughout the study area while cottontails were most common around manmade structures at the Pfister Place. Numerous mice and voles inhabit the study area of which the deer mouse is likely the most common.

During a previous study conducted by Cleveland-Cliffs Iron Company, mist netting was conducted to determine bat species inhabiting the area. The species verified during this survey are listed in **Table D9-1**.

3.3 Avifauna

Studies conducted to determine the presence, habitat association and production of avifauna on the North Butte project area focused on raptors, sage grouse, passerine and other bird species. In addition to specific surveys discussed below, opportunistic sightings of raptors, sage grouse, and other birds were recorded during field activities. Avifauna nomenclature conforms to The Checklist of North American Birds (AOU 1957) and subsequent revisions (AOU 1973, AOU 1976).

3.4 Raptors

Raptor species observed on or in the vicinity of the study area are listed in **Table D9-2**. Raptor sightings are shown on **Plate D9-1**.

No raptor nests were located on the North Butte permit area. Within one mile of the permit area several nest sites were located on North Butte, however, none of these nests appeared to be active during 1988.

Golden eagles were the most conspicuous year-round residents in the study area and vicinity. They were observed frequently throughout the year flying over the study area or roosting on fence posts and power poles. During studies conducted by Cleveland-Cliffs in 1978-1979, an active golden eagle nest was located on the southeast point of North Butte. No trace of this nest could be found during 1988.

Bald eagles were only observed in the vicinity of the study area during the winter months. A total of seven individuals were sighted during the period from December through March. Of these seven, six were adults and one immature. No known bald eagle roosts or winter concentration areas are known to occur in the vicinity of the study area. Bald eagle activity in the Pumpkin Buttes area probably begins with their arrival sometime in November and their departure sometime in March or April. The origins of the bald eagles wintering in the area are unknown.

Other raptors observed during the spring and summer of 1988 are the red-tailed hawk, marsh hawk, ferruginous hawk, Swainson's hawk, rough-legged hawk, American kestrel and the prairie falcon. Of these species, only the rough-legged hawk, a winter resident, is not known to nest in the Pumpkin Buttes area. While the other species are known to nest in the area, no active nests were located during 1988.

3.5 Game Birds

No sage grouse leks are located within the North Butte permit area. There are however, two strutting grounds located in the near vicinity which are shown on **Plate D9-1**. According to Wyoming Game and Fish records, these leks are known as the North Butte lek (T44N, R75W, Section 18) and the Gilbertz III lek (T44N, R75W, Section 21). The first observation of cocks on the Gilbertz III lek was during the second week in March when four individuals were observed. The maximum number of cocks observed was during the first two weeks of April when 10 and 11 were observed. The final observation of strutting activity on this lek was during the second week of May when two individuals were observed. The following table lists the maximum number of cocks observed on this lek during the past ten years.

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Cocks Seen	60+	46	39	NC	NC	17	8	9	NC	11
NC = No count conducted										

Cocks were first observed on the North Butte lek during the last week of March 1988 when four and six individuals were observed on two consecutive days. Subsequent checks of this lek did not reveal any strutting cocks until mid-April when a lone individual was observed. Only two known counts have been done on this lek in the past. One, conducted in 1979, counted six cocks and the other in 1981 counted three. Use of the North Butte lek appears to be relatively low and it may be that it is a satellite of the Gilbertz III lek.

No sage grouse nests were observed on the permit area but it is likely that some individuals nest on or adjacent to the permit area. During June, female sage grouse and their broods were observed throughout the permit area in the sagebrush and grassland habitat types.

Mourning doves were the only other upland game bird observed within the study area. They are quite common and were most often observed in the juniper habitat on the flanks of North Butte. During the late 1970's, a flock of approximately 20 gray partridge were often seen within the permit area. None were observed during the current study and they may no longer inhabit the area since suitable habitat is limited.

No waterfowl were observed in the study area.

3.6 Passerine and Other Birds

A list of bird species observed and potentially occurring on the study area are presented in **Table D9-2**.

The permit area proper supports an avifauna typical of grassland-sagebrush habitats in central Wyoming. North Butte, along with the juniper, pines and small springs on its flanks, provides additional habitat for species which might not otherwise be present, thereby increasing the overall diversity of the area.

3.7 Herptiles

A list of herptiles that could occur and those that were observed on the North Butte study area are presented in **Table D9-3**.

3.8 Threatened, Endangered and Other Species of Special Concern

Three Federally listed endangered species, the bald eagle, peregrine falcon and black-footed ferret, are potential inhabitants of the study area.

Bald eagles are commonly observed in the vicinity of the study area during the winter months. The Pumpkin Buttes provide roosting areas for the eagles which likely hunt throughout the surrounding region. Live streams for foraging are lacking in the Pumpkin Buttes area. While suitable nesting substrate is available on the Buttes, no known nesting has occurred in the area. As noted in previous studies, bald eagles may winter in the vicinity but migrate to more suitable habitat in the spring.

Peregrine falcons are considered a rare migrant and winter visitant in Wyoming. Suitable nesting substrate for the peregrine is available on the rimrock areas of the Buttes. However, no known nesting has occurred in the area. One positive sighting of a peregrine falcon was reported in April, 1979, near North Butte. Sightings of peregrines in the area would most likely be a chance occurrence while individuals are migrating through the area.

Black-footed ferrets are not expected to occur on the permit or study area due to the absence of active prairie dog colonies.

Three species considered rare in Wyoming, the burrowing owl, spotted bat and the pale milk snake, could potentially occur in the study area. Habitat for the burrowing owl, prairie dog colonies, are absent on the study area and the owl is not likely to occur. The rimrock of the Buttes seems to provide suitable habitat for the spotted bat. However, the spotted bat is only known to occur in the Big Horn Basin and is not likely to occur in the study area. The pale milk snake is secretive in nature and occupies a variety of habitats ranging from coniferous forests, broadleaf woodlands, and river bottoms to rocky hillsides, prairie and sand dunes. It is not known if it inhabits the study area.

3.9 Important Wildlife Habitats

Three habitat types, existing within the study area, have been identified as being important to wildlife of the area. These are: 1) Drainages with cottonwoods and junipers which can be of importance to mule deer and migratory and breeding birds; 2) Juniper and pine stands on the slopes of North Butte which attract birds that may not otherwise inhabit the area and; 3) The rimrock area of North Butte which provides important nesting, roosting and perching habitat for raptorial species.

3.10 Aquatic Fauna

Due to the lack of water on the study area, no investigations of aquatic fauna were conducted.

3.11 Recreation

Sport hunting is the only form of outdoor recreation on the study area. As most land in the area is private surface, hunting access is restricted by the landowner who generally allows only pronghorn hunting.

4.0 WILDLIFE MANAGEMENT PLAN

4.1 Introduction

Site-specific baseline vegetation and wildlife data for the North Butte ISL Project area combined with the proposed mine plan form the basis for assessment of potential impacts to wildlife resources resulting from the proposed development. The objectives of this plan are to identify impacts and define procedures for minimizing undesirable effects of mine development on the wildlife resources in the North Butte ISL Project area.

The proposed project involves the construction and operation of an in-situ solution uranium mine located in portions of Section 18 and 19, T44N, R75W and Sections 13, 24 and 25, T44N, R76W. The project will involve seven mine units, plant facilities and liquid effluent evaporation ponds. The mining is expected to be completed in 16 years, after which the affected aquifers will be restored, all structures except those left for landowner use, will be removed, wastes disposed of and all affected surface areas reclaimed.

4.2 Impacts

Impacts on wildlife resources from mining activities may be classified as either short-term or long-term. Short-term impacts are those that result directly from and occur during mining operations but, assuming reclamation efforts are successful, cease after reclamation. Long-term impacts are those that persist even after successful reclamation efforts. Long-term impacts usually result indirectly from mining activities and are much more difficult to identify and evaluate (e.g. potential permanent reduction in the local pronghorn population as a result of decreased quantity and quality of forage due to changes in nutrient cycling). Most of the impacts identified for the North Butte ISL project area resulting from development activities are considered to be of a short-term nature provided reclamation is successful.

Impacts may occur at a number of different levels of population organization ranging from the individual through herds or groups to the entire population. Since most of the anticipated impacts on the North Butte ISL Project Area are of a short-term nature or are restricted to the disturbed site and immediately adjacent areas, few lasting effects are anticipated at the regional population level for most species (e.g., the partial elimination of small mammals or mammalian predators during mining activities but the full recovery to baseline population levels after successful reclamation).

The general categories of potential impact to wildlife resources expected from the development at the North Butte ISL Project and severity ratings of each impact on the wildlife components in the study area are presented in **Table D9-4**. This table is the basis for the subsequent discussion of impact to wildlife in the North Butte ISL Project Area.

4.2.1 Modification of Vegetation

Vegetation will be temporally removed from approximately 49 acres presently covered by upland habitats. The disturbed area will not be suitable for wildlife habitat while the mine is operating and reclamation will not replace equivalent habitat immediately. The severity of this impact on wildlife is variable among the wildlife species occurring in the area.

Pronghorn and mule deer use the area as summer/yearlong range. Individuals that normally grazed or bedded in and adjacent to areas to be affected will likely move to suitable adjacent habitat. The removal, by the project, of a small amount of habitat will have slight overall impact. Mammalian predators will also likely use undisturbed habitat nearby rather than the disturbed area. The primary impact on predators due to modification of vegetation will likely be loss of potential prey due to the reduction in small mammals in affected areas. However, factors other than the amount of prey (e.g., coyote hunting and poisoning) may limit some of the predators in the area. Although small and medium-sized mammals will be reduced in the affected areas, they are expected to re-invade the area after mining is completed and vegetation is reestablished after reclamation.

No active raptor nests are known to occur in the vicinity of the proposed operations. The main impact on raptors due to vegetation modification is associated with the reduction of small mammal prey species on affected areas. This reduction in potential prey may affect those raptors which hunt in the area but it is not expected to limit raptor populations in the area.

Habitat used for nesting by passerine birds will be reduced. However, populations outside of the localized disturbed areas are not expected to be adversely affected and passerines should re-invade the areas upon re-establishment of vegetation after reclamation.

Relatively few reptiles and amphibians inhabit the areas to be affected and, therefore, relatively few herptiles should be affected.

Impacts on threatened or endangered species due to vegetation modification are not anticipated.

4.2.2 Water Supply Alterations

Water resources, which are an important component of wildlife habitat, are absent on the North Butte permit area. Drainages and impoundments in the vicinity only contain water for brief periods following snow melt or precipitation events. Therefore, the North Butte ISL project is not likely to affect any water supply currently available to wildlife. However, the water supply for wildlife could be increased during the life of the mine if surface discharge of water is conducted.

4.2.3 Airborne Emissions

Airborne emissions are expected to have little if any impact on wildlife species in the area. Air quality regulations that limit the kind and amount of emissions, including the release of radioactive gases, must be met. An increase in airborne particulates, during construction activities, may allow vegetation downwind from the operation to be covered with more dust than usual. This could potentially cause a decrease in vegetation productivity which would decrease forage available to wildlife. However, this potential impact would be limited to areas adjacent to development which would be avoided by most wildlife species. Emissions from the facility will be monitored and maintained within safe radiological protection limits for man, so no major radiological impact to wildlife is anticipated.

4.2.4 Direct Wildlife Mortality

Direct mortality may occur to wildlife such as small mammals and young birds that inhabit areas to be disturbed and that are not able to move rapidly enough to avoid equipment. This mortality may be severe at the localized disturbance but most of these animals reproduce rapidly and should re-invade the area if proper habitat is provided by reclamation.

The other major potential source of direct mortality will be vehicle-wildlife collisions. Although this impact could affect all wildlife species, the primary concern will be for pronghorn, mule deer, medium-sized mammals and raptors.

Approximately 50 Uranerz employees will be involved in the construction and operation of the North Butte ISL facility. Access to the site is provided by an existing county road extending northwest from Highway 50 to the North Butte ISL access road. The terrain is relatively open, which allows good visibility, so most collisions with pronghorn and mule deer can be avoided. The potential for collisions with raptors is present if carrion on or along the road attracts and holds them near the roadway. Due to the limited number of vehicle-wildlife collisions expected, the overall affect of direct wildlife mortality attributed to the North Butte ISL Project is expected to be slight.

4.2.5 Presence of Development, Associated Humans and Noise

Increased human activity associated with mine development increases the potential impact on several wildlife species. Most wild animals, particularly those that are hunted, avoid contact with humans by moving away. The distance they move depends on numerous factors including intensity and duration of human activity, cover, topography, weather, species of animal and previous experience of animals with humans. This avoidance reaction increases the habitat rendered less suitable for wildlife. This impact could be moderate to severe for individual animals in the vicinity of the development. However, the small size of the project area limits the severity of impact at the herd level.

Wildlife oriented recreation may be affected in several ways. Personnel at the mine will participate in wildlife viewing. Hunters may not hunt near the mine for aesthetic reasons while others may be attracted due to improved access. Poaching by workers is discouraged by requirements that personnel on duty at the mine not possess firearms on site. Hunting in the project area is controlled by the landowners.

The operation of the North Butte ISL project should have no effect on either the Gilbertz III or the North Butte sage grouse leks. The North Butte lek is located east of (and outside of) the permit area where no activities are planned. The Gilbertz III lek is located on both sides of the county road about two miles east of the permit area. Traffic to the mine will normally be coming from the south and exiting the county road before passing the Gilbertz III lek area. The same is true of traffic leaving the mine. This lek area is already influenced by the substantial oil and gas related traffic that uses the county road.

Human activity and unsuitable habitat conditions on disturbed sites are expected to keep most wildlife out of potentially dangerous areas such as the recovery facility and evaporation ponds. These potentially dangerous areas will be fenced to exclude large wildlife and livestock. Uranerz does not plan to fence the well field areas. If the well fields are fenced, Type III fencing design (Guideline No.

10) will be utilized. Plans to mitigate and monitor potential impacts associated with the development are presented in the next section.

4.3 Mitigation and Monitoring

Severe impacts on, or long-term reduction in wildlife populations due to the proposed development are not expected in the vicinity of the North Butte ISL Project. However, several different types of less severe, but nonetheless adverse, impacts will occur. Mitigating measures are not possible for all impacts, however, reduction of impact and mitigation measures that are possible are described in this section. The wildlife monitoring plan to document changes in wildlife use of the area is also described. Monitoring will be conducted throughout the life of the project so that impact mitigation measures can be modified if necessary. The U.S. Fish and Wildlife Service Endangered Species Office in Helena, Montana will be notified in the event a federal listed threatened or endangered species not reported in the baseline study begins to use the permit area or adjoining surfaces.

4.3.1 Modification of Vegetation

The reclamation plan for the North Butte ISL Project commits CR to restoration of disturbed areas as soon as practicable. The reclamation plan describes measures to be employed in re-establishing vegetation, a major habitat component necessary for wildlife habitation. Revegetation success will be monitored at appropriate intervals so reclamation can be modified, if necessary, to assure that areas will not be out of production any longer than necessary. Additionally, only the minimum area necessary for the project will be disturbed.

To encourage successful reclamation as soon as possible after disturbance, CR will use tested and acceptable reclamation techniques and land owner approved seed mixtures that are adapted to the conditions on the permit area. Vegetation establishment will also be enhanced by natural invasion. The linear, relatively narrow configuration of the ore body, which determines the size and shape of the disturbed area in the well field, is conducive to more rapid invasion than would a similar amount of disturbed land that was more consolidated. Also, not stripping topsoil from the well field areas will reduce disturbed acreage and encourage more rapid revegetation.

Successful reclamation will produce vegetation cover that will probably be repopulated first by small mammals and passerine birds. Although the initial diversity of small mammal and passerine bird species in the reclaimed area may be low, their numbers should be sufficient to restore any prey base lost to raptors and mammalian predators. During the summer, pronghorn and mule deer may use the reclaimed area, but they will likely bed down in undisturbed areas that have more dense cover than the reclaimed area.

4.3.2 Water Supply Alterations

The water supply in the project area will not be affected by the proposed operations.

4.3.3 Direct Wildlife Mortality

CR will encourage safe driving habits and reasonable speed while driving on the access road to reduce the potential for wildlife-vehicle collisions. The amount of traffic for the North Butte ISL Project will not likely cause wildlife-vehicle collisions to the point that additional measures will be necessary.

During the life of the project the evaporation ponds will be inspected at least monthly for wildlife. Results of the monthly inspection will be included in the Annual Reports. During the monthly inspection of the ponds the entire shoreline will be walked to determine if any waterfowl or other wildlife mortalities have occurred. If dead or emaciated birds or other wildlife are found, they will be picked up, labeled, and frozen in a plastic bag. The District III Game and Fish Department in Sheridan will be notified immediately. CR will have all power lines at the North Butte site constructed so as to avoid raptor electrocution as outlined in Olendoff R.R., A. D. Miller and R. M. Lehman, 1981.

4.3.4 Presence of Development, Associated Humans and Noise

Several measures to reduce potential adverse impacts on wildlife due to the presence of the development, associated humans and noise will be implemented. Potentially dangerous areas such as the evaporation ponds and processing facility will be fenced to exclude large terrestrial wildlife. Although the use of evaporation ponds by wildlife is not expected due to the presence of humans nearby and fencing, they will be periodically monitored. If monitoring of potentially dangerous areas indicate that wildlife are being attracted to those areas and subsequently harmed, appropriate techniques will be employed to reduce the impact.

Nesting raptorial birds are particularly susceptible to disturbance impacts in the vicinity of their nesting sites. Unusual disturbance near an active nest site may cause birds to abandon their nests. The licensee will monitor all known raptor nests and potential nesting sites on a yearly basis. Any active raptor nests will be protected from disturbance during the reproductive season. If a nest cannot be avoided during operations, the appropriate state and federal agencies will be consulted to determine mitigative measures. A special purpose permit will be obtained from the U.S. Fish and Wildlife Service in the event it becomes necessary to 'take" a raptor nest. Permit acquisition will be coordinated with the

U.S.F.W.S. Ecological Services Office in Cheyenne and sufficient lead time will be allowed for development of a mitigation plan, should one be deemed necessary.

Employees will be instructed to avoid harassment of all wildlife in the vicinity of the project area. Any employee or contractor involved in deliberate acts of wildlife harassment will receive appropriate reprimands.

4.4 Annual Wildlife Surveys

4.4.1 Annual Raptor Surveys

An annual raptor survey will be conducted each spring on the permit area and within a one mile perimeter of the permit area. The species, status, and reproduction success will be determined for all active nests observed in the survey area. The data from the annual raptor survey will be included in the Annual report to the Land Quality Division.

4.4.2 Annual Game Bird Surveys

An annual sage grouse survey will be conducted each March-April period within a one mile perimeter of the permit area. The survey will include two counts of each known lek at approximately 7 to 10 day intervals. Searches will be conducted for new or previously unrecorded leks in suitable habitat areas. The number of males and females counted on each lek, along with the dates and conditions under which counts were made will be recorded. The data from the annual sage grouse survey will be included in the Annual Report to the Land Quality Division.

APPENDIX D9
WILDLIFE

List of Tables

Table D9-1 Potential Mammalian Inhabitants

Scientific Nomenclature	Common Name
INSECTIVORA	
Soricidae	
Sorex cinereus	Masked shrew
Sorex merriami	Merriam's shrew
CHIROPTERA	
Vespertilionidae	
Myotis lucifugus*	Little brown myotis[1]
Myotis evotis*	Long-eared myotis[1]
Eptesicus fuscu*	Big brown bat[1]
Myotis leibii*	Small footed myotis[1]
Myotis volans*	Long-legged myotis[1]
Plecotus townsendii	Townsend's big-eared bat
Lasiurus cinereus	Hoary bat
LAGOMORPHA	
Leporidae	
Lepus californicus	Black-tailed jack rabbit
Lepus townsendii*	White tailed jack rabbit
Sylvilagus audubonii*	Desert cottontail
Sylvilagus nuttallii	Nuttall's cottontail
RODENTIA	
Sciuridae	
Cynomys ludoviciana	Black-tailed prairie dog
Eutamias minimus*	Least chipmunk
Spermophilus richardsonii	Richardso's ground squirrel
Spermophilus tridecemlineatus*	Thirteen-lined ground squirrel
Geomydiae	
Thomomys talpoides*	Northern pocket gopher
Heteromyidae	
Perognathus fasciatus*	Olive-backed pocket mouse
Dipodomys ordii*	Ord's kangaroo rat
Cricetidae	
Microtus ochrogaster*	Prairie vole
Microtus pennsylvanicus*	Meadow vole
Lagurus curtatus*	Sagebrush vole
Microtus longicaudus*	Long-tailed vole
Neotoma cinerea*	Bushy-tailed wood rat
Onychomys leucogaster*	Northern grasshopper mouse
Peromyscus maniculatus*	Deer mouse
Reithrodontomys megalotis*	Western harvest mouse
Odatra zibethicus	Muskrat
Zapodiae	
Zapus princeps	Western jumping mouse
Erethizontidae	
Erethizon dorsatum	Porcupine
CARNIVORA	
Canidae	
Canis latrans*	Coyote
Vulpes vulpes*	Red fox
Mustelidae	
Mephitis mephitis*	Striped skunk
Spilogale putorius	Spotted skink
Taxidea taxus*	Badger

Scientific Nomenclature	Common Name
Mustela frenata	Long-tailed weasel
Mustela vison	Mink
Felidae	
Felis rufus	Bobcat[1]
Felis concolor	Mountain lion[1]
Procyonaidae	
Procyon lotor	Raccoon
ARTIODACTYLA	
Antilocapridae	
Antilocapra americana*	Pronghorn
Cervidae	
Odocoileus hemionus*	Mule deer
* Verified Inhabitant 1. Observed during the 1979 Cleveland-Cliffs study.	

Table D9-2 Bird Species Observed or Likely to Occur on or Near the Cameco Resources North Butte ISL Project Site

Latin Name[1]	Common Name	Status[2]
ANATIDAE		
Branta Canadensis	Canada goose	L, M
Anas platyrhynchos	Mallard	L, B
Anas strepera	Gadwall	L, B
Anas acuta	Pintail	L, M
Anas crecca	Green-winged teal	L, M
Anas discors	Blue-winged teal	L, B
Anas cyanoptera	Cinnamon teal	L, B
Anas americana	American wigeon	L, M
Anas clypeata	Northern shovler	L, M
Aythya americana	Redhead	L, M
Aythya valisineria	Canvasback	L, M
Aythya collaris	Ring-necked duck	U, M
Aythya affinis	Lesser scaup	L, M
Bucephala albeola	Bufflehead	U, M
Oxjura jamaicensis	Ruddy duck	L, M
Mergus merganser	Common merganser	L, R
CATHARTIDAE		
Cathartes aura	Turkey vulture	L, S
ACCIPITRIDAE		
Accipiter striatus	Sharp-shinned hawk	L, B
Accipiter cooperii	Cooper's hawk	L, B
Accipiter gentilis	Goshawk	U, W
Buteo jamaicensis	Red-tailed hawk	O, R
Buteo swainsonii	Swainson's hawk	O, B
Buteo lagopus	Rough-legged hawk	O, W
Buteo regalis	Ferruginous hawk	O, R
Aquila chysaetos	Golden eagle	O, R
Haliaeetus leucocephalus	Bald Eagle	O, W
Circus cyaneus	Marsh hawk	O, R
FALCONIAE		
Falco mexicanus	Prairie falcon	O, R
Falco peregrinus	Peregrine falcon	U, M
Falco columbarius	Merlin	L, M
Falco sparverius	American kestrel	O, R
Falcos rusticolus	Gyrfalcon	U, W
TETRAONIDAE		
Centrocercus urophasianus	Sage grouse	O, R
Dendragapus obscurus	Blue grouse	U, R
PHASIANIDAE		
Alectoris chukar	Chukar partridge	U, R
Perdix perdix	Gray partridge	L, R
RALLIDAE		
Falica americana	American coot	L, S
Rallus limicola	Virginia rail	L, B
Porzana carolina	Sora	L, B
RECURVIROSTRIDE		
Recurvirostra americana	American avocet	L, M
Charadrius		
Charadrius vociferous	Killdeer	O, B
Pluvialis squatarola	Black-bellied plover	U, M

Latin Name[1]	Common Name	Status[2]
SCOLOPACIDAE		
Limosa fedoa	Marbled godwit	U, M
Bartramia longicauda	Upland sandpiper	L, B
Actitis muculata	Spotted sandpiper	L, B
Tringa solitaria	Solitary sandpiper	L, M
Tringa melanoleucus	Greater yellowlegs	L, M
Tringa flavipes	Lesser yellowlegs	L, M
Catoptrophorus semipalmatus	Willet	U, M
Limodromus scolopaceus	Long-billed dowitcher	U, M
Micropalama himanotopus	Stilt sandpiper	U, M
Calidris melanotos	Pectora sandpiper	L, M
Calidris bairdii	Baird's sandpiper	L, M
Calidris minutilla	Least sandpiper	U, M
Calidris pusillus	Semipalmated sandpiper	U, M
Calidris mauri	Western sandpiper	U, M
PHALAROPODIDAE		
Steganopus tricolor	Wilson's phalarope	O, M
Lobipes lobatus	Northern parlarope	L, M
LARIDAE		
Larus argentatus	Herring gull	U, M
Larus californicus	California gull	L, M
Larus delawaresis	Ring-billed gull	U, M
Larus pipixcan	Franklin's gull	L, S
COLUMBIDAE		
Zenaida macroura	Morning dove	O, B
STRIGIDAE		
Otus asio	Screech owl	U, R
Bubo virginianus	Great horned owl	O, R
Glaucidium gnoma	Pygmy owl	U, R
Athene cunicularia	Burrowing owl	L, B
Asio otus	Long-eared owl	L, W
Asio flammeus	Short-eared owl	L, W
Nyctea scandiaca	Snowy owl	U, W
CAPRIMULGIDAE		
Phalaenoptilus nuttalli	Poor-will	O, B
Chordeiles minor	Common nighthawk	O, B
APODIDAE		
Aeronautes saxatalis	White-throated swift	L, S
TROCHILIDAE		
Selasphorus platycercus	Broad-tailed hummingbird	L, S
ALCEDINIDAE		
Megaceryle alcyon	Belted kingfisher	L, R
PICIDAE		
Colaptes auratus	Common flicker	O, R
Melanerpes erythrocephalus	Red-headed woodpecker	O, B
Sphyrapicus varius	Yellow-ellied sapsucker	L, M
Picoides villosus	Hairy woodpecker	U, R
Picoides pubescens	Downy woodpecker	O, R
TYRANNIDAE		
Tyrannus tyrannus	Eastern kingbird	O, B
Tyrannus verticalis	Western kingbird	O, B
Sayornis saya	Say's phoebe	O, B
Empidonax trailli	Willow flycatcher	U, B
Empidonax minimus	Least flycatcher	O, B

Latin Name[1]	Common Name	Status[2]
Empidonax difficilis	Western flycatcher	O, B
Contopus sordidulus	Western wood pewee	O, B
ALAUDIDAE		
Eremophila alpestris	Horned lark	O, R
HIRUNDINIDAE		
Tachycineta thalassina	Violent-green swallow	O, S
Iridoprocne bicolor	Tree swallow	L, B
Riparia riparia	Bank swallow	O, B
Steligdopteryx ruficollis	Rough-winged swallow	L, B
Hirundo rustica	Barn swallow	O, B
Petrochelidon pyrrhonata	Cliff swallow	O, B
CORVIDAE		
Cyanocitta cristata	Blue jay	U, R
Aphelocoma coerulescens	Scrub jay	U, R
Gymorhinus cyanocephalus	Pinyon jay	O, R
Pica pica	Black-billed magpie	O, R
Corvus corax	Common raven	L, R
Corvus brachyrhynchos	Common crow	L, R
PARIDAE		
Parus atricapillus	Black-capped chickadee	L, R
Parus gambeli	Mountain chickadee	L, W
SITTIDAE		
Sitta carolinensis	White-breasted nuthatch	L, R
Sitta canadensis	Red-breasted nuthatch	O, W
CERTHIDAE		
Certhia familiaris	Brown creeper	O, W
THRAUPIDAE		
Piranga ludoviciana	Western tanager	L, B
TROGLODYTIDAE		
Troglodytes aedon	House wren	O, B
Salpinctes obsoletus	Rock wren	O, B
Cistothorus palustris	Marsh wren	U, B
MIMIDAE		
Dumetella carolinensis	Gray catbird	U, B
Toxostoma rufum	Brown thrasher	U, B
Oreoscoptes montanus	Sage thrasher	O, B
TURDIDAE		
Turdus migratorius	American robin	O, B
Catharus guttatus	Hermit thrush	L, M
Catharus ustulatus	Swainson's thrush	L, M
Siala sialis	Eastern bluebird	U, B
Siala mexicana	Western bluebird	L, B
Siala curricoides	Mountain bluebird	O, B
SYLVIIDAE		
Regulus calendula	Ruby-crowned kinglet	L, M
MOTACILLIDAE		
Anthus spinoletta	Water pipit	L, B
BOMBYCILLIDAE		
Bombycilla garrulus	Bohemian waxwing	O, W
Bombycilla cedrorum	Cedar waxwing	L, M
LANIIDAE		
Lanius excubitor	Northern shrike	L, W
Lanius ludovicianus	Loggerhead Shrike	O, B

Latin Name[1]	Common Name	Status[2]
STURNIDAE		
Sturnus vulgaris	Starling	O, R
VIREONIDAE		
Vireo olivaceous	Red-eyed vireo	L, B
Vireo solitarius	Solitary vireo	L, M
Vireo gilvus	Warbling vireo	O, B
PARULIDAE		
Mniotilla varia	Black and white warbler	L, M
Vermivora calata	Orange-crowned warbler	L, M
Dendroica petchia	Yellow warbler	O, B
Dendroica coronata	Yellow-rumped warbler	L, M
Seiurus novaboracensis	Northern waterthrush	L, M
Geothlypis trichas	Common yellowthroat	L, B
Icteria virens	Yellow-breasted chat	U, B
Oporornis tolmiei	MacGillivray's warbler	U, M
Wilsonia pusilla	Wilson's warbler	L, M
Setophaga ruticilla	American redstart	L, B
Passer domesticus	House sparrow	O, R
ICTERIDAE		
Dolichonyx oryzivorus	Bobolink	U, S
Sturnella neglecta	Western meadowlark	O, R
Xanthocephalus xanthocephalus	Yellow-headed blackbird	L, B
Agelaius phoeniceus	Red-winged blackbird	O, B
Euphagus cyanocephalus	Brewer's blackbird	O, B
Quiscalus quiscula	Common grackle	O, B
Molothrus ater	Brown-headed cowbird	O, B
Icterus galbula	Northern oriole	O, B
Icterus bullockii	Bullock's oriole	L, S
FRINGILLIDAE		
Pheucticus melanocehpalus	Black-headed grosbeak	L, B
Hesperiphona verspertina	Evening grosbeak	L, W
Passerina amoena	Lazuli bunting	L, B
Passerina cyanea	Indigo bunting	U, S
Carpodacus purpureus	Purple finch	U, M
Carpodacus cassinii	Cassin's finch	U, W
Carpodacus mexicanus	House finch	L, R
Leucosticte tephrocotis	Gray-crowned rosy finch	L, W
Carduelis flammea	Common redpoll	U, W
Carduelis pinus	Pine siskin	L, R
Spinus tristis	American goldfinch	L, R
Pipilo chlorurus	Green-tailed towhee	L, B
Pipilo erythrophthalmus	Rufous-sided towhee	L, B
Calamospiza melanocorys	Lark bunting	O, B
Passerculus sandwichensis	Savannah sparrow	L, B
Poocetes gramineus	Vesper sparrow	O, B
Chondestes grammacus	Lark sparrow	O, B
Junco hyemalis	Dark-eyed junco	L, W
Spizella arborea	Tree sparrow	L, W
Spizella passerina	Chipping sparrow	L, B
Spizella pallida	Clay-colored sparrow	L, S
Spizella breweri	Brewer's sparrow	O, B
Zonotrichia leucophrys	White-crowned sparrow	L, M
Zonotrichia albicolis	White-throated sparrow	U, M
Melospiza lincolnii	Lincoln's sparrow	L, B

Latin Name[1]	Common Name	Status[2]
Melsopiza melodia	Song sparrow	L, B
Calcarius mccownii	McCown's longspur	L, B
Calcarius lapponicus	Lapland longspur	L, W
Calcarius ornatus	Chestnut-collared longspur	L, B
Plectrophenax nivalis	Snow bunting	O, W

1. Nomenclature based on AOU (1957, 1973, 1976)
2. Status:
   O=Observed, **L**=Likely, **U**=Unlikely, but possible; either this area is peripheral range or no suitable habitat is found on the site, **B**=Breeder, **M**=Migrant, **W**=Winter Visitor, **R**=Year-round Resident, **S**=Summer Resident

Table D9-3 Amphibians and Reptiles Observed or Expected to Occur Within the Cameco Resources Ruth ISL Project Site

Latin Name	English Name	Status[2]
AMPHIBIA		
Ambystoma tigriunum	Tigar salamander	O
Scaphiopus bombifrons	Plains spadefoot	L
Bufo cognatus	Great Plains toad	L
B. woodhousei	Rocky Mountain toad	L
Rana pipiens	Leopard frog	O
Pseudacris triseriata	Western chorus frog	L
REPTILIA		
Sceloporus graciosus	Sagebrush lizard	O
Phrynosoma douglassii	Short-horned lizard	O
Heterodon nasicus	Plains hognose snake	L
Coluber constrictor	Yellow-bellied racer	L
Pituophis melanoleucus	Gopher (bull) snake	O
Lampropeltis triangulum	Pale milk snake	U
Thamnophis sirtalis	Common garter snake	L
T. elegans	Wandering garter snake	L
T. radix	Plains garter snake	O
Crotalus viridis	Western (prairie) rattlesnake	O
Status – **O** = Observed, **L**=Likely to occur, **U**-Not likely to occur		

Table D9-4 Ratings for Potential Impacts on Wildlife Components

	Impactors[1, 2]				
	A	**B**	**C**	**D**	**E**
Pronghorn	3	4	3	3	3
Mule Deer	3	4	3	3	3
Other Mammals	3	4	3	3	3
Predators	3	4	3	3	3
Game Birds	3	4	3	3	3
Raptors	3	4	3	3	3
Other Avifauna	3	4	3	3	3
Herptiles	3	4	3	3	3
Important Habitat	4	4	4	-	4
Recreation	4	4	4	4	4
T&E Species	4	4	4	4	4

1. A = Modification of Vegetation
   B = Water Supply Alterations
   C = Airborne Emissions
   D = Direct Wildlife Mortality
   E = Presence of Development, Associated Humans, and Noise

2. Impact Ratings
   1 = Severe
   2 = Moderate
   3 = Slight
   4 = Unanticipated

APPENDIX D9
WILDLIFE

List of Plates

The following 1 Drawing specifically referenced Appendix D9 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

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APPENDIX D9
WILDLIFE

List of Attachments

NAME *Uranerz North Butte Project* **WILDLIFE OBSERVATION FORM**
MONTH *Dec* YEAR *1987*

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
18	935	M	5					Sec 23								
		F	15													
		?			8			NWSE	44	76	23		4.10		13	
18	352	M						SEC 17								
		F														
		?	2		1			SWSE	44	75			4.10		17	
21	932	M	1					SEC 25								
		F	3													
		?						NENE	44	75	19		4.10		14	
21	932	M	2					Sec 13								
		F														
		?						SWSW	44	76	19				14	
21	932	M	2					Sec 22								
		F														
		?						NWSE	44	76	19				05	
21	903	M						SEC 12								
		F														
		?	1					SESE	44	76			4.10		15	
21	915	M						Sec 26								
		F														
		?	1					NENW	44	76			4.10		14	
21	349	M						Sec 13								
		F														
		?	1					NWSW	44	76			4.10		03	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH Dec YEAR 1987

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
21	352	M						Sec 7								
		F						SESW								
		?	1					~~[illegible]~~	44	75					17	
21	349	M						Sec 13								
		F														
		?	1					NWSW	44	76					17	
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uragerz N. Butte Project
MONTH Jan YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
19	932	M	6					Sec 7								
		F	15					SWSE	44	75	19		4,10		05	
		?		12												
19	352	M						Sec 7								
		F														
		?	1					SESW	44	75					17	
19	935	M	16					Sec 21								
		F	41					NWNW	44	75	23		410		05	
		?		32												
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH Feb YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
26	349	?	1					Sec 13 SWSE	44	76					17	
26	347	?	1					Sec 13 NWNW	44	76					17	
26	935	?				37		Sec 16 NWSW	44	75	23		4.10		05	
26	935	M	1					Sec 26 NENE	44	76	23		4.10		05	
26	935	?				57		Sec 28 NENW	44	75	23		4.10		05	
		M / F / ?														
		M / F / ?														
		M / F / ?														

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH March YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
9	309	M	4					Sec 21								
		F														
		?						SW 1/4	44	75			7.00		01	
9	349	M						Sec 17								
		F														
		?	1					NWSE	44	75					17	
9	349	M						Sec 24								
		F														
		?						NWSW	44	76					17	
9	935	M	5					Sec 17								
		F	12													
		?		8				SWNW	44	75	23		4.10		05	
9	935	M	1					Sec 13								
		F	1													
		?						SESE	44	76	23		4.10		14	
9	932	M						Sec 23								
		F	3													
		?		1				SWNE	44	76	19		4.10		05	
18	309	M	5					Sec 21								
		F														
		?						SW 1/4	44	75			7.00		01	
18	349	M						Sec 19								
		F														
		?	1					SWSW	44	75					17	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME *Uranerz N. Butte Project* | WILDLIFE OBSERVATION FORM | ( ) AFFIL. | ( ) DISTRICT | ( ) LEAVE BLANK

MONTH *March* YEAR *1988*

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
22	309	M	9					Sec 21								
		F	[illegible]					SW 1/4	44	75			7.00		01	
24	309	M	6					Sec 21 SW 1/4	44	75			7.00		01	
24	932	?				26		Sec 25 SENW	44	76	19		4.10		05	
24	932	F	6					Sec 23 SESE	44	76	19		4.10		05	
31	932	?				15		Sec 24 NWSE	44	76	19		4.10		05	
31	309	M	6					Sec 21 SW 1/4	44	75			7.00		01	
31	309	M	6					Sec 18 SW 1/4	44	75			7.00		01	
31	932	?				11		Sec 24 NESW	44	76	19		4.10		05	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH March YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
31	932	M						Sec 24								
		F	6	2												
		?						SESW	44	76	19		4,10		14	
31	932	M	1					Sec 25								
		F	10													
		?		6				NWNE	44	76	19		410		13	
18	932	M						Sec 14								
		F	4													
		?						SWNE	44	76	19		5,00		13	
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														
		M														
		F														
		?														

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH April YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Adult	Yrlg.	Juv.	Uncl.	Spec Age	1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
7	309	M	9					Sec 21								
		F	2					SW 1/4	44	75			7.00		01	
7	355	?	2					Sec 14 SWNW	44	76					17	
7	331	?	2					Sec 19 SENE	44	75					17	
7	349	?	2					Sec 25 SWNE	44	76					03	
7	932	F	12					Sec 24								
		?		5				SWSW	44	76	19		4.10		14	
7	935	M	1					Sec 24 SW SW	44	76	23		4.10		14	
7	342	?	1					Sec 14 SESW	44	76					17	
13	309	M	1					Sec 18 SW 1/4	44	75			7.00		01	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH April YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
13	309	M	11					Sec 21 SW 1/4	44	75			7.00		01	
13	355	?	1					Sec 14 SW NW	44	76					17	
20	309	M	12					Sec 21 SW 1/4	44	75			7.00		01	
20	932	F	8					Sec 24 NWSW	44	76			4.10		05	
		?		5												
20	348	?	1					Sec 23 NE SW	44	76					17	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Uranerz N. Butte Project
MONTH May YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
5	309	M	3					Sec 21 SW1/4	44	75			7.00		01	
5	349	?	1					Sec 21 NWSW	44	75			[illegible]		17	
5	349	?	2					Sec 25 SWNE	44	76					03	
5	915	?	1					Sec 24 SWSW	44	76			4.10		14	
13	309	M	1					Sec 21 SW1/4	44	75			7.00		01	
13	349	?	1					Sec 24 SWNE	44	76					03	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME *Uranerz N. Butte Project*   **WILDLIFE OBSERVATION FORM**   (___) AFFIL.   (___) DISTRICT   (___) LEAVE BLANK

MONTH *June* YEAR *1988*

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
7	360	M						Sec 19								
		F														
		?	1					SWSW	44	75					03	
13	337	M						Sec 14								
		F														
		?	1					NENE	44	76					17	
13	349	M						Sec 23								
		F														
		?	1					NENW	44	76					17	
		M														
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Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Drumerz N. Butte Project
MONTH July YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
22	349	M						Sec 25								
		F														
		?			2			SWNE	44	76					03	
		M														
		F														
		?														
		M														
		F														
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NAME Uranerz N. Butte Project
MONTH August YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
18	349	M						Sec19								
		F														
		?	2		1			SWSW	44	75					17	
19	349	M						Sec 25								
		F														
		?	2					SWNE	44	76					17	
19	349	M						Sec 36								
		F														
		?	1					NWNW	44	76					17	
		M														
		F														
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NAME Uranerz N. Butte Project
MONTH Sept YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
17	935	M	2					Sec 18								
		F	9													
		?		8				SWNE	44	75	23		4.10		05	
17	935	M	1					Sec 19								
		F														
		?						NENE	44	75	23		4.10		13	
17	935	M						Sec 20								
		F	2													
		?		3				SENE	44	75	23		4.10		05	
17	935	M	1					Sec 13								
		F	4													
		?		3				NENE	44	76	23		4.10		14	
17	935	M	–					Sec 25								
		F	8													
		?		6				SESE	44	76	23		4.10		05	
17	935	M	2					Sec 26								
		F														
		?						NENW	44	76	23		4.10		13	
17	932	M						Sec 13								
		F	8													
		?		6				SWSW	44	76	19		3.20		13	
17	932	M	2					Sec 14								
		F														
		?						NWSW	44	76	19		5.00		14	

Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

NAME Urunerz N. Butte Project
MONTH Sept YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
17	932	M	1					Sec 24								
		F	3													
		?		2				NWNW	44	76	19		4.10		05	
17	932	M						Sec 25								
		F	5													
		?		3				SENW	44	76	19		4.10		05	
27	932	M						Sec 24								
		F	8	5				SENW	44	76	19		4.10		13	
		?														
27	932	M	1					Sec 13								
		F	11													
		?		7				SWSW	44	76	19		5.00		05	
27	932	M	1					Sec 25								
		F						SENE	44	76	19		4.10		05	
		?														
27	932	M	1					Sec 26								
		F	5													
		?		2				SENE	44	76	19		4.10		05	
27	935	M	3					Sec 18								
		F	13													
		?		8				NENE	44	75	23		4.10		05	
27	935	M	1					Sec 13								
		F														
		?						SENE	44	76	23		4.10		13	

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NAME Uranerz N. Butte Project
MONTH Sept YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
		M	1					Sec 24								
27	935	F	3													
		?		2				NW NW	44	76	23		4.10		05	
		M						Sec 25								
27	935	F	5													
		?		3				SE NW	44	76	23		4.10		14	
		M														
		F														
		?														
		M														
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NAME Uranerz N. Butte Project
MONTH Nov YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
4	935	M	1					Sec 30 NWNE	44	75	23		4.10		13	
		F														
		?														
4	935	M	1					Sec 18 NENE	44	75	23		4.10		05	
		F	7													
		?		3												
4	935	M						Sec 18 NWSW	44	75	23		4.10		15	
		F	3													
		?		2												
4	935	M						Sec 16 SWNW	44	75	23		4.10		05	
		F	9													
		?		5												
4	935	M	2					Sec 26 NESW	44	76	23		4.10		14	
		F	14													
		?		9												
4	935	M	1					Sec 25 SESE	44	76	23		4.10		13	
		F														
		?														
4		M						Sec 14 SESE	44	76	19		5.00		13	
		F	4													
		?		3												
4		M	1					Sec 14 SWSW	44	76	19		5.00		13	
		F														
		?														

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NAME Uranerz N. Butte Project
MONTH November YEAR 1988

WILDLIFE OBSERVATION FORM

( ) AFFIL. ( ) DISTRICT ( ) LEAVE BLANK

DAY	SPECIES	SEX	Circle All Estimates: Adult	Yrlg.	Juv.	Uncl.	Spec Age	Location: 1/4 Twp. or Sec.	Twp.	Rng.	HUNT AREA NO.	Degree Block NO.	HAB. DESC. NO.	MORT. CODE NO.	ACT. CODE NO.	NOTES
4	932	M	1					Sec 13								
		F						SWSW	44	76	19		4.10		13	
		?														
4	932	M						Sec 24								
		F	7					NWNW	44	76	19		4.10		05	
		?		4												
4	932	M	1					Sec 25								
		F	1					NWNE	44	76	19		4.10		05	
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Use 1 line for each animal when specific age over 1+ is to be recorded.
Circle any number entered that represents a partial count of a group of animals.

ADDENDUM D9-1
WILDLIFE MONITORING PLAN

Table of Contents

Please note: All tables, figures and attachments are located behind the tabs following this Addendum.

Tables

Figures

Attachments

ADDENDUM D9-1
WILDLIFE MONITORING PLAN

1.0 INTRODUCTION

The 1,089-acre North Butte Permit Area of Power Resources (d.b.a. Cameco Resources) is located in the Pumpkin Buttes area of the Powder River Basin in southwestern Campbell County, Wyoming. In June 2010, Cameco Resources (CR) retained the services of Hayden-Wing Associates, LLC (HWA) to prepare a revised Wildlife Monitoring Plan and Wildlife Survey Report for their in-situ uranium extraction operation in the North Butte Permit Area. The Permit Area is located approximately 50 miles south of Gillette and 110 miles north of Casper, Wyoming in Sections 18 and 19, T44N:R75W and Sections 13, 24, and 25, T44N:R76W. Elevation across the Permit Area ranges from approximately 4,900 to 5,700 feet and is gently sloping grassland range with deeply incised drainages. The Permit Area is located entirely on private lands (**Figure D9-1.1**).

According to **Appendix D9** to Wyoming Department of Environmental Quality-Land Quality Division (DEQ-LQD) 2006 permit to mine application for North Butte (TFN 4 3/268), four vegetation types exist within one mile of the North Butte Permit Area. These include:

1) Grassland with high sagebrush density – found throughout much of the Permit Area, includes big sage (*Artemisia tridentata*) and silver sage (*A. cana*).

2) Grassland with low sagebrush density – found in upland areas east and north of the Permit Area on gently rolling plains.

3) Cottonwood riparian – plains cottonwoods (*Populus deltoides*) found primarily along the Willow Creek drainage; they also exist as isolated trees in smaller drainages.

4) Juniper woodlands – found along the slopes of North Butte. This type ranges from widely scattered junipers (*Juniperus sp*) with a sagebrush (*Artemisia spp*) understory to dense junipers with scattered limber pine (*Pinus flexilis*). Scattered junipers also occur within drainages throughout the survey area.

Additionally, the rim rock of North Butte is composed of short steep sandstone cliffs which may function as important raptor habitat for nesting, roosting, and perching.

2.0 OBJECTIVES

The purpose of this Wildlife Monitoring Plan is to set forth protocols and schedules for monitoring the status of wildlife species identified by the regulatory agencies as species of concern that may occur in or proximal to CR's Permit Area. As suggested in DEQ-LQD Guideline No. 5 (HH/5-80; ST/2-87 revised; Rules Update/8-94), this monitoring plan has been "designed to obtain data in sufficient detail to evaluate the effect of mining on the wildlife species in question and to develop mitigation proposals." This plan has been tailored to meet the specific wildlife monitoring needs of CR's North Butte In-situ Uranium Recovery Project and does not address species that are unlikely to occur in the survey area. This is in keeping with DEQ-LQD Guideline No. 5 (HH/5-80; ST/2-87 revised; Rules Update/8-94), which states: "Since monitoring is intended to evaluate wildlife problems on Permit Areas, there is no need for blanket monitoring of all species."

3.0 PROCEDURES

3.1 Target Species

Survey and monitoring efforts will be focused on target species (**Table D9-1.1**). Target species were identified using two lists. These are:

1) Species designated as Threatened or Endangered, Proposed Species, Candidate Species, or Species of High Federal Concern by the United States Fish and Wildlife Service (USFWS); see August 19, 2010 letter of Matt Hogan to Jeff Winstead in **Attachment D9-1.1**); and

2) Species designated as species of concern by Wyoming Game and Fish Department (WGFD) that are known to occur or are likely to occur (according to **Appendix D9** to the DEQ-LQD 2006 permit to mine application for North Butte) within two miles of the Permit Area.

The list of Target Species presented in **Table D9-1.1** includes all species that are known to occur or are likely to occur within two miles of the Permit Area, that are listed by the USFWS and/or WGFD as species of overall conservation concern. During the course of wildlife monitoring during the life of the mining operation, annual opportunistic observations will be made of all target and non-target species detected in the survey area. For a subset of these species, formal surveys were requested by USFWS (as per August 19, 2010 letter of Matt Hogan to Jeff Winstead) and/or by WGFD (as per May 13, 2010 conversation of Scott Gamo and Jeff Winstead). The probability of occurrence and monitoring protocol for each target species or species group is hereby discussed in further detail.

Black-tailed Prairie Dog

No black-tailed prairie dog colonies are known to occur in the Permit Area. Monitoring efforts will include annual searches for prairie dog colonies within the Permit Area, mapping of the boundaries of any colonies discovered, and observations of colonies to determine activity status.

Swift Fox

No swift foxes are known to occur within 0.25 miles of the Permit Area. Swift foxes are closely associated with prairie dog colonies and select habitat with low-growing vegetation, relatively flat terrain, and high den availability. Although there are small patches of marginal habitat within 0.25 miles of the Permit Area, they are isolated from contiguous habitat outside of the survey area by areas of steep terrain and high sagebrush density. Spotlight surveys will be conducted in and within 0.25 miles of the Permit Area. Surveys will be conducted by paired observers and will consist of shining a spotlight while slowly driving roads and two-tracks. Spotlight surveys will be conducted for three consecutive nights, and can be conducted at any season, though ability to detect foxes is likely to be highest during pup emergence in late July and early August. If a swift fox is detected an attempt will be made to locate its den. Results of this survey will be reviewed by WGFD to determine if annual surveys are needed.

Wild Ungulates

Mule deer and pronghorn are present within the Permit Area. Because neither species is on the target species list, and the Permit Area is not within WGFD-designated crucial big game range for any ungulate species, formal big game surveys will not be performed. Opportunistic observations will be recorded for any species encountered.

Bats

During a previous study conducted by Cleveland Cliffs Iron Company, mist netting was conducted to determine bat species inhabiting the area. Seven bat species are on the target list. Six species of bats are known to occur in the vicinity of the Permit Area and one is likely to occur. Though no formal surveys will be conducted, opportunistic observations will be recorded for any species encountered.

Mice and Voles

Two species of voles and one species of mouse are on the target list. All three species are known to occur in the vicinity of the Permit Area. Though no formal surveys will be conducted, opportunistic observations will be recorded for any species encountered.

Greater Sage-grouse

Three active sage-grouse leks occur within a two-mile radius of the Permit Area. One aerial survey of the Permit Area and its two-mile buffer will be conducted each year during April to search for new or previously undocumented leks. In order to determine trends in local sage-grouse populations, ground counts on known leks will be conducted three times during the leking season using protocols dictated by the WGFD. Surveys will be coordinated with other wildlife consultants in the area to avoid duplicating survey efforts and to minimize disturbance to the grouse. Because the Permit Area does not lie within a WGFD-designated core population area for sage-grouse, no habitat mapping or detailed demographic studies will be conducted. In addition to lek counts, any opportunistic observations of sage-grouse will be recorded.

Mountain Plover

Mountain plovers have not been observed within the survey area. Currently no suitable breeding habitat for mountain plovers exists in the Permit Area due to topography and dense vegetation. In some flat areas it is possible for suitable mountain plover habitat to exist in the future, primarily if prairie dogs colonize the area or if changes in land use cause a dramatic increase in livestock grazing. The Permit Area and a 0.25 mile buffer will be searched each year for mountain plover habitat; if new habitat patches are located, they will be mapped, and three ground surveys for mountain plovers and active nests will be conducted annually in suitable habitat. These surveys will be carried out in accordance with current USFWS protocols.

Raptors (Orders Falconiformes, and Strigiformes)

Thirteen species of raptor are known to occur and three species are likely to occur within or near the Permit Area. Seven of the sixteen are target species because they are on the WGFD species of concern list or are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668). All sixteen species are protected under the Migratory Bird Treaty Act (16 U.S.C. 703). As such, any destruction of a nest or cause of abandonment of a nest is prohibited without a permit. Each year, an aerial survey will be conducted in and within one mile of the Permit Area during late April or early May to determine the activity status of known nests and to search for new nests. In late May, ground surveys will be conducted for nests observed to be active during aerial surveys, and for nests not located during aerial surveys. In late June, ground surveys will be conducted to determine the productivity of active nests located during the previous surveys. Target raptor species are discussed in further detail below.

Bald Eagle

Suitable nesting habitat for bald eagles does not exist in the Permit Area because there are no perennial streams with large, mature trees in the area. Bald eagles have been observed in the vicinity of the Permit Area during the winter, but no winter roosts were found during surveys conducted in 1987 and 1988 by Applied ECOsystems, and suitable winter roost habitat does not appear to exist. Winter roost surveys will not be conducted. In addition to raptor nest surveys (described above), any opportunistic observations of bald eagles will be recorded.

Golden Eagle

Golden eagles have been observed in the survey area. There is one golden eagle nest within one mile of the Permit Area, which was inactive and in poor condition in 2010. In addition to raptor nest surveys (described above), any opportunistic observations of golden eagles will be recorded.

Ferruginous Hawk

Ferruginous hawks have been observed in the survey area and suitable nesting habitat exists, but no known ferruginous hawk nests occur within one mile of the Permit Area. In addition to raptor nest surveys (described above), any opportunistic observations of ferruginous hawks will be recorded.

Burrowing Owl

Burrowing owls inhabit dry open areas with short grass and no trees. They prefer to use prairie dog burrows for nesting, but will use abandoned burrows of other mammal species (i.e. badger) and are capable of excavating their own burrow. There are no prairie dog colonies within one mile of the Permit Area, but some areas of marginal habitat occur within the survey area. These areas will be searched for burrowing owls during the late May and late June raptor surveys. If a prairie dog colony becomes established in or within one mile of the Permit Area, formal burrowing owl surveys will be conducted in July and August. If a burrowing owl nest is located it will be monitored annually for activity. Any opportunistic observations of burrowing owls will be recorded.

Merlin

Merlins have not been observed in the vicinity of the Permit Area, but the presence of juniper woodlands and open grassland may provide suitable breeding habitat, and the presence of sizable limber pines and a high density of black-billed magpie nests may provide suitable nesting substrates. In addition to raptor nest surveys (described above), any opportunistic observations of merlins will be recorded.

Short-eared Owl

Short-eared owls are associated with ungrazed and undisturbed native grasslands and wetlands that support dense small mammal populations. They have been observed within the vicinity of the Permit Area and pockets of suitable habitat may exist within one mile of the Permit Area. In addition to raptor nest surveys (described above), any opportunistic observations of short-eared owls will be recorded.

Swainson's Hawk

Swainson's hawks have been observed in the vicinity of the Permit Area. No known nests occur within one mile of the Permit Area, but suitable breeding habitat and nesting substrates exist. In addition to raptor nest surveys (described above), any opportunistic observations of Swainson's hawks will be recorded.

Other Bird Species

In addition to greater sage-grouse, mountain plover, and raptors, 46 other bird species have been observed in the vicinity of the Permit Area, and 76 other bird species were identified in **Appendix D9** to the DEQ-LQD 2006 permit to mine application for North Butte as likely to occur in the vicinity of the Permit Area. Fifteen species are on the target list because they are on the WGFD species of concern list. All but three of the 122 species are protected under the Migratory Bird Treaty Act (16 U.S.C. 703).

To update baseline data, avian point count surveys will be conducted to inventory grassland bird species and other associated species in the area. Surveys will be conducted between April and June. Survey points will be established 100 m apart along 1,000 m transect lines in each habitat type within the Permit Area. The observer will walk from point to point and record all bird species seen or heard within a 50-m radius of each survey point for five minutes. Each set of survey points will be surveyed from 0.5 hours after sunrise to 0930 hours for three consecutive mornings.

Amphibians

There are six species of amphibians on the target list, and two have been observed in the vicinity of the Permit Area. Though no formal surveys will be conducted for these species, opportunistic observations will be recorded for any species encountered.

Reptiles

There are nine species of reptiles on the target list, and four have been observed in the vicinity of the Permit Area. Though no formal surveys will be conducted for these species, opportunistic observations will be recorded for any species encountered.

3.2 Wildlife Monitoring Surveys

An outline and schedule of annual wildlife surveys to be conducted is presented below.

Late March to Early May

- Conduct one aerial survey of Permit Area and surrounding two-mile buffer to search for previously undiscovered leks. Surveys will be performed from sunrise to one hour after sunrise in a fixed-wing aircraft flying at an altitude of 100 to 200 feet above the ground and airspeeds of 60 to 70 miles per hour. Transects will be located approximately 0.5 miles apart and flown in a north-south direction starting on the east side of the survey area.
- Conduct three ground counts of sage-grouse on the three known leks and any new leks discovered. These will be conducted 7 to 10 days apart, from 0.5 hours before sunrise to one hour after sunrise.

Late April to Early May

- Conduct one aerial survey of Permit Area and surrounding one-mile buffer to determine activity status of known raptor nests and to search for new or previously undiscovered raptor nests.

Early May to Mid-June

- If mountain plover habitat is discovered within the Permit Area, presence/absence and nesting surveys will be conducted following USFWS protocol.

April to June

- Conduct breeding bird point count surveys in each habitat type within the Permit Area. Surveys will be conducted for three consecutive mornings.

Late May to Early June

- Conduct ground survey of raptor nests that were active or not located during the aerial survey.

Late June to Early July

- Conduct ground survey to determine productivity of active nests located during previous surveys.

April to August

- During 2011, conduct three swift fox spotlight surveys in and within 0.25 miles of the Permit Area. Surveys will be conducted by paired observers and will consist of shining a spotlight while slowly driving roads and two-tracks. Spotlight surveys will be conducted for three consecutive nights. If a swift fox is detected no further fox surveys will be required that year, but an attempt will be made to locate the fox's den.
- Search the Permit Area for black-tailed prairie dog colonies. Map perimeter and determine activity status of any colonies within the Permit Area.
- Search the Permit Area and 0.25-mile buffer for mountain plover habitat. Map perimeter of any mountain plover habitat present.

3.3 Monitoring of Mining Disturbance and Effectiveness of Reclamation

Disturbance

The surface acreage of wildlife habitats disturbed by mining activities will be documented and monitored annually. Disturbances will be classified as: short-term, long-term, and permanent/life of mine.

- Short-term disturbances include temporary activities that are reclaimed within the same year within which the disturbance occurred.
- Long-term disturbances include longer lasting activities where reclamation activities extend for longer than one year.
- Permanent, or life-of-mine disturbances include roads, buildings, and other features that will remain throughout the life of the mine or longer.

Parameters monitored will include:

- Acres of short-term, long-term, and permanent/life-of-mine disturbances within each of the wildlife habitats (vegetation types).
- Percent of total acreage within each wildlife habitat type that has been disturbed.
- Annual percentage of un-reclaimed disturbance.

Reclamation

The surface acreage of wildlife habitats reclaimed each year will be monitored annually and the effects on wildlife species documented.

Parameters monitored will include:

- Acres of short-term and long-term disturbances within each wildlife habitat (vegetation types and other un-vegetated habitats) that have been reclaimed.
- Percent of total disturbed acreage within each wildlife habitat type that is reclaimed each year.
- Percent of total acreage within each wildlife habitat type that has been reclaimed.
- The locations of wildlife documented during the annual wildlife surveys will be determined for each wildlife habitat and reclaimed area with short-term, long-term and life-of-mine comparisons made.
- Species composition of vegetation that is becoming established in the reclaimed areas and the relative rate of establishment for each species.

The effectiveness of this monitoring plan will be evaluated annually by CR, DEQ-LQD, and the WGFD and adjusted to accommodate additional needs or changes in circumstances that become apparent over time.

ADDENDUM D9-1
WILDLIFE INVENTORY PLAN

List of Tables

Table D9-1.1 List of Target Species for Cameco Resources' North Butte In-Situ Uranium Recovery Project[1]

Common Name	Scientific Name	USFWS	WGFD
MAMMALS			
Black-tailed Prairie Dog	*Cynomys ludovicianus*	x	x
*Long-eared Myotis	*Myotis evotis*		x
Townsend's Big-eared Bat	*Corynorhinus townsendii*		x
*Long-legged Myotis	*Myotis volans*		x
Swift Fox	*Vulpes velox*		x
*Big Brown Bat	*Eptesicus fuscu*		x
*Little Brown Myotis	*Myotis lucifugus*		x
*Olive-backed Pocket Mouse	*Perognathus fasciatus*		x
*Prairie Vole	*Microtus ochrogaster*		x
*Western Small-footed Myotis	*Myotis leibii*		x
*Hoary Bat	*Lasiurus cinereus*		x
*Sagebrush Vole	*Lagurus curtatus*		x
BIRDS			
*Greater Sage-grouse	*Centrocercus urophasianus*	x	x
Mountain Plover	*Charadrius montanus*	x	x
*Bald Eagle	*Haliaeetus leucocephalus*	x	x
*Golden Eagle	*Aquila chrysaetos*	x	
*Ferruginous Hawk	*Buteo regalis*		x
Long-billed Curlew	*Numenius americanus*		x
*Brewer's Sparrow	*Spizella breweri*		x
*Burrowing Owl	*Athene cunicularia*		x
Sage Sparrow	*Amphuspiza belli*		x
Sage Thrasher	*Oreoscoptes montanus*		x
Canvasback	*Aythya valisineria*		x
Lesser Scaup	*Aythya affinis*		x
Merlin	*Falco columbarius*		x
Northern Pintail	*Anas acuta*		x
Redhead	*Aythya americana*		x
Virginia Rail	*Rallus limicola*		x
*Lark Bunting	*Calamospiza melanocorys*		x
*Short-eared Owl	*Asio flammeus*		x
*Swainson's Hawk	*Buteo swainsoni*		x
Bobolink	*Dolixhonyx oryzivorus*		x
Chestnut-collared Lonspur	*Calcarius ornatus*		x
Great Blue Heron	*Ardea herodias*		x
McCown's Longspur	*Calcarius mccownii*		x
Upland Sandpiper	*Bartramia longicauda*		x
AMPHIBIANS			
*Northern Leopard Frog	*Rana pipiens*		x
*Tiger Salamander	*Ambystoma tigrinum*		x
Boreal Chorus Frog	*Pseudacris maculata*		x
Great Plains Toad	*Bufo cognatus*		x
Plains Spadefoot	*Spea bombifrons*		x
Woodhouse's Toad	*Bufo Woodhousii*		x

REPTILES			
Prairie Rattlesnake	*Crotalus viridis viridis*		x
*Bullsnake	*Pituophis menalnoleucas sayi*		x
*Greater short horned lizard	*Phrynosoma hernandes hernandesi*		x
*Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*		x
*Plains Garter Snake	*Thamnophis radix*		x
Common Garter Snake	*Thamnophis sirtalis*		x
Eastern Yellow-bellied Racer	*Couber constrictor flaviventris*		x
Intermountain Wandering Gartersnake	*Thamnophis elegans vagrans*		x
Plains hog-nosed snake	*Heterodon nasicus nasicus*		x

[1]This species list is comprised of: 1) species designated as Threatened or Endangered, Proposed Species, Candidate Species, or Species of High Federal Concern by the USFWS, and 2) species designated as species of concern by WGFD that are known to occur or are likely to occur (according to the D9-Wildlife Appendix to the WDEQ-LQD 2006 permit to mine application for North Butte) within two miles of the Permit Area.

*Species that have been observed in the vicinity of the Permit Area. Observations include 1) detections during the course of 2010 surveys by HWA, 2) detections during 1987 and 1988 surveys by Applied ECOsystems, 3) detections during 1978 and 1979 surveys conducted by Bio/West, 4) WGFD records of detections within two miles of the Permit Area, and 5) Wyoming Natural Diversity Database records of detections within six miles of the Permit Area.

ADDENDUM D9-1
WILDLIFE MONITORING PLAN

List of Figures

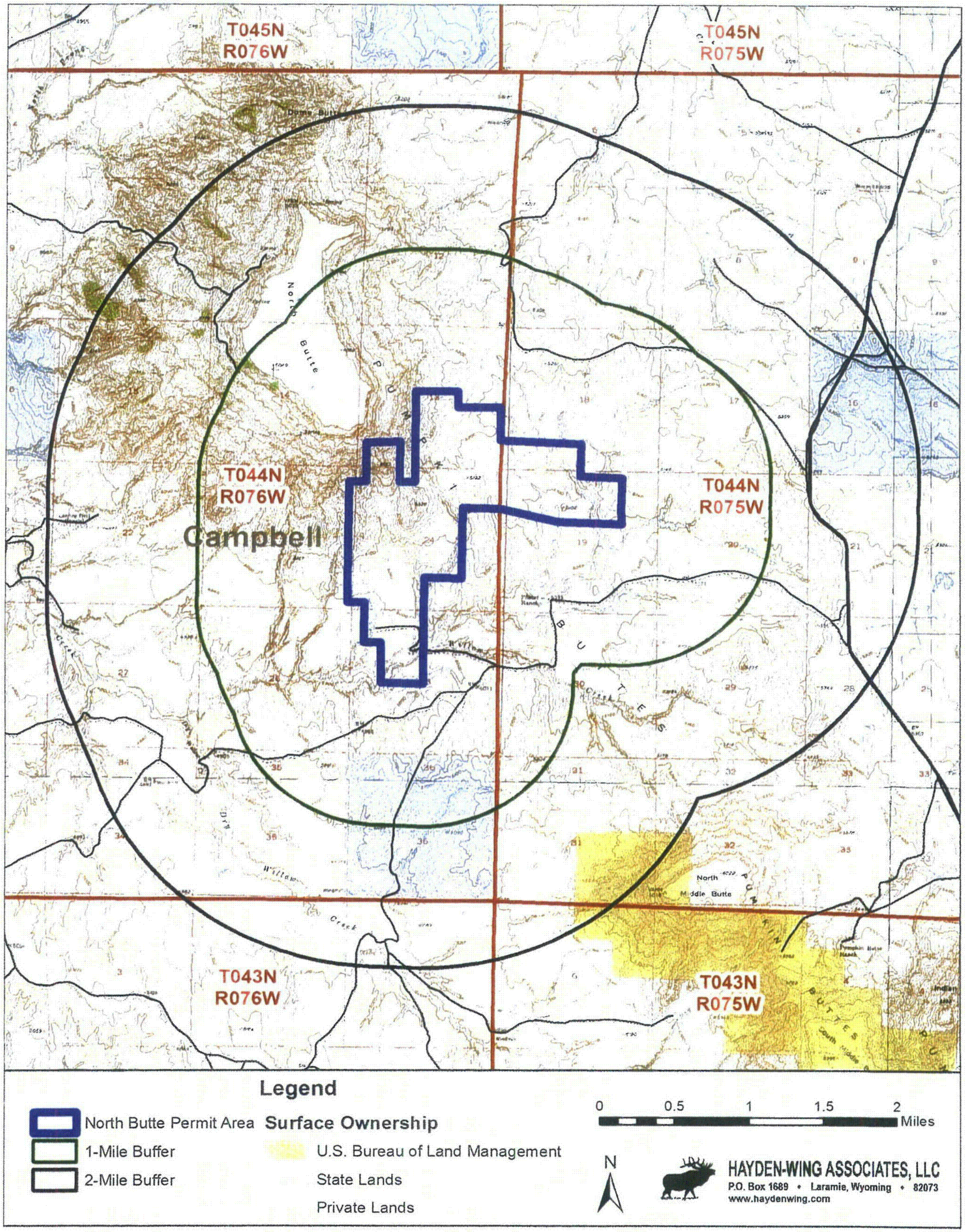

Figure D9-1.1 Location of North Butte Permit Area in Campbell County, Wyoming

ADDENDUM D9-1.1
WILDLIFE

List of Attachments

WYOMING GAME AND FISH DEPARTMENT

5400 Bishop Blvd. Cheyenne, WY 82006

Phone: (307) 777-4600 Fax: (307) 777-4610

Web site: http://gf.state.wy.us

December 17, 2010

WER 5743.01
Hayden-Wing Associates, LLC
Request for a List of Wildlife Surveys to Conduct
North Butte In-Situ Uranium Recovery Project
Cameco Resources
Campbell County

Jeff Winstead
Principal Biologist/Co-Owner
Hayden -Wing Associates, LLC
Natural Resource Consultants
2308 South 8th Street
Laramie, WY 82070

Dear Mr. Winstead:

The staff of the Wyoming Game and Fish Department has reviewed the request for a list of Wildlife Surveys to conduct for the North Butte In-Situ Uranium Recovery Project submitted by Cameco Resources in Campbell County. We offer the following comments for your consideration.

In reference to Hayden –Wing Associates October 28 email we are providing the needed surveys for this project as follows.

- Survey for sage grouse leks inclusive of a 2-mile buffer of the project boundary.
- Survey raptor nests within one mile of the project boundary.
- Conduct spotlight surveys for swift fox.
- Conduct point count surveys for grassland birds and associated bird species.

We further recommend mapping prairie dog colonies as this will help evaluate the forage base for raptors. Additional surveys for mountain plovers may be of value as well. For additional survey recommendations for non-game species (including raptors) we recommend coordinating with the US Fish and Wildlife Service Ecological Service office in Cheyenne.

"Conserving Wildlife - Serving People"

Mr. Jeff Winstead
December 17, 2010
Page 2 - WER 5743.01

Thank you for the opportunity to comment. If you have any questions or concerns, please contact Scott Gamo, Staff Terrestrial Biologist, at 307-777-4509.

Sincerely,

for John Emmerich
Deputy Director

JE:MF:sg

cc: USFWS
Lynn Jahnke-WGFD, Sheridan

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

AUG 1 8 2010

In Reply Refer To:
ES-61411/WY10SL0339

Mr. Jeffrey B. Winstead
Hayden-Wing Associates, LLC
P.O. Box 1689
Laramie, Wyoming 82073-1689

Dear Mr. Winstead:

Thank you for your letter of July 9, 2010, received in our office on July 19, regarding the Cameco Resources North Butte In Situ Recovery Mine. Cameco Resources is planning to recover uranium via an in-situ leach process on a permit area of approximately 1,039 acres in the Pumpkin Buttes area in Campbell County, Wyoming. This mine was originally permitted in 1991, but mining operations have been sporadic to non-existent. The mine is located in sections 13, 23, 24, and 25 of T. 44 N., R. 76 W. and sections 18 and 19 of T. 44 N., R. 75 W. You have requested a list of species of concern for this area.

The Service is providing you with information regarding species listed under the Endangered Species Act of 1973, as amended (Act), 16 U.S.C. 1531 *et seq.*, and recommendations for protective measures for threatened and endangered species in accordance with the Act. We are also providing recommendations concerning migratory birds in accordance with the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703, and the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668. Wetlands are afforded protection under Executive Orders 11990 (wetland protection) and 11988 (floodplain management), as well as section 404 of the Clean Water Act. Other fish and wildlife resources are considered under the Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 *et seq.*, and the Fish and Wildlife Act of 1956, as amended, 16 U.S.C. 742a-742j.

In accordance with Section 7(c) of the Act, we have determined that the following species or their designated habitat may be present in the proposed project area. We would appreciate receiving information as to the current status of each of these species within the proposed project area.

Listed, Proposed, Candidate Species and their Designated and Proposed Critical Habitat that may be in the proposed Project Area

Species/Critical Habitat	Scientific Name	Status	Habitat
Ute Ladies'-tresses	*Spiranthes diluvialis*	Threatened	Seasonally moist soils and wet meadows of drainages below 7,000 ft. elevation
Greater Sage-Grouse	*Centrocercus urophasianus*	Candidate	Sagebrush communities
Mountain Plover	*Charadrius montanus*	Proposed	Grasslands and prairie dog towns

Ute ladies'-tresses: Ute ladies'-tresses (*Spiranthes diluvialis*) is a perennial, terrestrial orchid, 8 to 20 inches tall, with white or ivory flowers clustered into a spike arrangement at the top of the stem. *S. diluvialis* typically blooms from late July through August; however, depending on location and climatic conditions, it may bloom in early July or still be in flower as late as early October. *S. diluvialis* is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams where it colonizes early successional point bars or sandy edges. The elevation range of known occurrences is 4,200 to 7,000 feet (although no known populations in Wyoming occur above 5,500 feet) in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows. Soils where *S. diluvialis* have been found typically range from fine silt/sand, to gravels and cobbles, as well as to highly organic and peaty soil types. *S. diluvialis* is not found in heavy or tight clay soils or in extremely saline or alkaline soils. *S. diluvialis* seems intolerant of shade and small scattered groups are found primarily in areas where vegetation is relatively open. Surveys should be conducted by knowledgeable botanists trained in conducting rare plant surveys. *S. diluvialis* is difficult to survey for primarily due to its unpredictability of emergence of flowering parts and subsequent rapid desiccation of specimens. The Service does not maintain a list of "qualified" surveyors but can refer those wishing to become familiar with the orchid to experts who can provide training or services.

Greater sage-grouse: The Service has determined that the greater sage-grouse (Centrocercus urophasianus) warrants listing under the Act (75 FR 13910). At this time, the development of a listing proposal is precluded by other higher priority listing actions. Candidates are reviewed annually to determine if they continue to warrant listing or to reassess their listing priority. Ideally, sufficient threats can be removed to eliminate the need for listing in which case sage-grouse would no longer be a candidate. If threats are not addressed or the status of the species declines, a candidate species can move up in priority for a listing proposal.

Greater sage-grouse are dependent on sagebrush habitats year-round. Please see our Federal Register notice on sage-grouse for detailed information concerning the status of the species (75 FR 13910). Habitat loss and degradation, as well as loss of population connectivity have been identified as important factors contributing to the decline of greater sage-grouse populations rangewide. Therefore, any activities that result in loss or degradation of sagebrush habitats that are important to this species should be closely evaluated for their impacts to sage-grouse. If important breeding habitat (leks, nesting or brood rearing habitat) is present in the project area, the Service recommends no project-related disturbance March 15 through June 30, annually. Minimization of disturbance during lek activity, nesting, and brood rearing is critical to sage-grouse persistence within these areas. Likewise, if important winter habitats are present, we recommend no project-related disturbance November 15 through March 14.

We recommend you contact the Wyoming Game and Fish Department to identify important greater sage-grouse habitats within the project area, and appropriate measures to minimize potential impacts from the proposed project. The State of Wyoming has adopted a "Core Population Area Strategy" Executive Order 2008-2 to ensure greater sage-grouse conservation. The recommendations of the State Sage-grouse Implementation Team and State of Wyoming's Greater sage-grouse "Core Population Area Strategy" Executive Order 2008-2 state that development of any type in the most important sage-grouse habitats (core areas and associated seasonal habitats) is done only when no decline to the species can be demonstrated. Executive Order 2008-2 further states the burden of proof for showing development does not affect sage-grouse rests with the industry or proponent in question, and any research they feel is necessary to convey this, should be conducted outside of core areas. The proposed project is located in an area designated by the State of Wyoming as a core sage-grouse population area. We recommend you pursue additional consultation with the Wyoming Game and Fish Department on the core area strategy as it relates to this project.

The Service recommends surveys and mapping of important greater sage-grouse habitats where local information is not available. The results of these surveys should be used in project planning, to minimize potential impacts to this species. No project activities that may exacerbate habitat loss or degradation should be permitted in important habitats.

Mountain Plover: On June 29, 2010, the Service reinstated a December 5, 2002, proposed rule (67 FR 72396) to list the mountain plover as a threatened species. Please see our recent Federal Register notice (75 FR 37353) for additional information. A new final determination on the proposal is to be completed by May 1, 2011. Pending the completion of the new final determination, the mountain plover is again proposed for listing as threatened. Section 7(a)(4) of the Act, requires Federal agencies to confer with us on any action that is likely to jeopardize the continued existence of any species proposed for listing. Federal action agencies may also request a conference on any proposed action that may affect a species proposed for listing.

We encourage project planners to develop and implement protective measures should mountain plovers occur within project areas. Measures to protect the mountain plover from further decline may include: (1) avoidance of suitable habitat during the plover nesting season (April 10 through July 10), (2) prohibition of ground disturbing activities in prairie dog towns, and (3) prohibition of any permanent above ground structures that may provide perches for avian predators or deter plovers from using preferred habitat. Suitable habitat for nesting mountain plovers includes grasslands, mixed grassland areas and short-grass prairie, shrub-steppe, plains, alkali flats, agricultural lands, cultivated lands, sod farms, and prairie dog towns. We encourage you to develop protective measures with an assurance of implementation should mountain plovers be found within the project areas.

Migratory Birds and Bald and Golden Eagles: The MBTA, enacted in 1918, prohibits the taking of any migratory birds, their parts, nests, or eggs except as permitted by regulations, and does not require intent to be proven. Section 703 of the MBTA states, "Unless and except as permitted by regulations ... it shall be unlawful at any time, by any means or in any manner, to ... take, capture, kill, attempt to take, capture, or kill, or possess ... any migratory bird, any part, nest, or eggs of any such bird..." The BGEPA prohibits knowingly taking, or taking with wanton disregard for the consequences of an activity, any bald or golden eagles or their body parts, nests, or eggs, which includes collection, molestation, disturbance, or killing.

Work that could lead to the take of a migratory bird or eagle, their young, eggs, or nests (for example, if you are going to erect new roads, or power lines in the vicinity of a nest), should be coordinated with our office before any actions are taken. Enclosed please find our general recommendations for the protection of bald eagles and other raptor species. We strongly encourage project proponents to fully implement the protective measures described in the enclosures in order to help ensure compliance with the MBTA and the BGEPA. We are also available to assist you in developing a project specific plan to address the MBTA and BGEPA concerns.

Removal or destruction of such nests, or causing abandonment of a nest could constitute violation of one or both of the above statutes. Removal of any active migratory bird nest or nest tree is prohibited. For golden eagles, inactive nest permits are limited to activities involving resource extraction or human health and safety. Mitigation, as determined by the local Service field office, may be required for loss of these nests. No permits will be issued for an active nest of any migratory bird species, unless removal of an active nest is necessary for reasons of human health and safety. Therefore, if nesting migratory birds are present on, or near the project area, timing is a significant consideration and needs to be addressed in project planning.

If nest manipulation is proposed for this project, the project proponent should contact the Service's Migratory Bird Office in Denver at 303-236-8171 to see if a permit can be issued for this project. No nest manipulation is allowed without a permit. If a permit cannot be issued, the project may need to be modified to ensure take of a migratory bird or eagle, their young, eggs or nest will not occur.

Wetlands/Riparian Areas: Wetlands may be impacted by the proposed project. Wetlands perform significant ecological functions which include: (1) providing habitat for numerous aquatic and terrestrial wildlife species, (2) aiding in the dispersal of floods, (3) improving water quality through retention and assimilation of pollutants from storm water runoff, and (4) recharging the aquifer. Wetlands also possess aesthetic and recreational values. If wetlands may be destroyed or degraded by the proposed action, those wetlands in the project area should be inventoried and fully described in terms of their functions and values. Acreage of wetlands, by type, should be disclosed and specific actions should be outlined to avoid, minimize, and compensate for all unavoidable wetland impacts.

Riparian or streamside areas are a valuable natural resource and impacts to these areas should be avoided whenever possible. Riparian areas are the single most productive wildlife habitat type in North America. They support a greater variety of wildlife than any other habitat. Riparian vegetation plays an important role in protecting streams, reducing erosion and sedimentation as well as improving water quality, maintaining the water table, controlling flooding, and providing shade and cover. In view of their importance and relative scarcity, impacts to riparian areas should be avoided. Any potential, unavoidable encroachment into these areas should be further avoided and minimized. Unavoidable impacts to streams should be assessed in terms of their functions and values, linear feet and vegetation type lost, potential effects on wildlife, and potential effects on bank stability and water quality. Measures to compensate for unavoidable losses of riparian areas should be developed and implemented as part of the project.

Plans for mitigating unavoidable impacts to wetland and riparian areas should include mitigation goals and objectives, methodologies, time frames for implementation, success criteria, and monitoring to determine if the mitigation is successful. The mitigation plan should also include a contingency plan to be implemented should the mitigation not be successful. In addition, wetland restoration, creation, enhancement, and/or preservation does not compensate for loss of stream habitat; streams and wetlands have different functions and provide different habitat values for fish and wildlife resources.

Best Management Practices (BMPs) should be implemented within the project area wherever possible. BMPs include, but are not limited to, the following: installation of sediment and erosion control devices (e.g., silt fences, hay bales, temporary sediment control basins, erosion control matting); adequate and continued maintenance of sediment and erosion control devices to insure their effectiveness; minimization of the construction disturbance area to further avoid streams, wetlands, and riparian areas; location of equipment staging, fueling, and maintenance areas outside of wetlands, streams, riparian areas, and floodplains; and re-seeding and re-planting of riparian vegetation native to Wyoming in order to stabilize shorelines and streambanks.

Species of Concern

Black-tailed prairie dog: The range of the black-tailed prairie dog (*Cynomys ludovicianus*) once spanned the short and mixed grass prairies of North America east of the Rockies from southern Canada to northern Mexico. This species still occurs over much of its historic range, although in more widely scattered large colonies. Black-tailed prairie dogs occur within the eastern third of Wyoming. A population thought to have been intentionally introduced outside of this range also occurs in the Bighorn Basin. We encourage the conservation of prairie dog colonies for their value to the prairie ecosystem and the many species that rely on them. Threats that may be significant to conserving black-tailed prairie dog populations include disease (sylvatic plague) and some control programs (poisoning). Prairie dogs serve as the primary prey species for the black-footed ferret and several raptors, including the golden eagle and ferruginous hawk. Prairie dog colonies and burrows also provide shelter or nest sites for species like the mountain plover and burrowing owl. Because black-tailed prairie dog colonies in Wyoming do not currently support any ferret populations, black-footed ferret surveys are not necessary in their colonies found within Wyoming. However, we do encourage evaluating black-tailed prairie dog colonies for the potential reintroduction of black-footed ferrets.

In-Situ Uranium Mining

High selenium concentrations can occur in wastewater from in situ mining of uranium ore as uranium-bearing formations are usually associated with seleniferous strata (Boon 1989). The disposal of this wastewater can expose migratory birds to selenium, which is known to cause impaired reproduction and mortality in sensitive species of birds such as waterfowl.

The in situ mining wastewater is typically disposed of through deep-well injection or discharge into large evaporation ponds. One mining operation in Converse County disposes of the wastewater through land application using center-pivot irrigation after treatment for removal of uranium and radium.

In 1998, the Service conducted a study of grassland irrigated with wastewater from an in situ uranium mine and found that selenium was mobilized into the food chain and bioaccumulated by grasshoppers and songbirds (Ramirez and Rogers 2002). Disposal of the in situ wastewater through irrigation is not recommended by the Service due to the potential for selenium bioaccumulation in the food chain and adverse effects to migratory birds and aquatic species. Additionally, land application may result in the contamination of groundwater and eventually seep out and reach surface waters. Additionally, the selenium-contaminated groundwater could seep into low areas or basins in upland sites and create wetlands which would attract migratory birds and other wildlife.

The Service is also concerned with the potential for elevated selenium in evaporation ponds receiving in situ wastewater. Waterborne selenium concentrations 2 ug/L are considered hazardous to the health and long-term survival of fish and wildlife (Lemly 1996). Additionally, water with more than 20 ug/L is considered hazardous to aquatic birds (Skorupa and Ohlendorf 1991). Chronic effects of selenium manifest themselves in immune suppression to birds (Fairbrother et al. 1994), which can make affected birds more susceptible to disease and predation. Selenium toxicity will also cause embryonic deformities and mortality (See et al. 1992, Skorupa and Ohlendorf 1991, Ohlendorf 2002).

If submerged aquatic vegetation and/or aquatic invertebrates are present in evaporation ponds with high waterborne selenium concentrations, extremely high dietary levels of this contaminant can be available to aquatic migratory birds. Ramirez and Rogers (2000) documented selenium concentrations ranging from 434 to 508 ug/L in pondweed (*Potamogeton vaginatus*) collected from a uranium mine wastewater storage reservoir that had waterborne selenium concentrations ranging from 260 to 350 ug/L.

For our internal tracking purposes, the Service would appreciate notification of any decision made on this project (such as issuance of a permit or signing of a Record of Decision or Decision Memo). Notification can be sent in writing to the letterhead address or by electronic mail to FW6_Federal_Activities_Cheyenne@fws.gov.

We appreciate your efforts to ensure the conservation of Wyoming's fish and wildlife resources. If you have questions regarding this letter or your responsibilities under the Act and/or other authorities or resources described above, please contact Pauline Schuette of my office at the letterhead address or phone (307) 684-1069.

Sincerely,

Matt Hogan
Acting Field Supervisor
Wyoming Field Office

Enclosures (2)

cc: WGFD, Non-game Coordinator, Lander, WY (B. Oakleaf)
WGFD, Statewide Habitat Protection Coordinator, Cheyenne, WY (M. Flanderka)

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U.S. Fish and Wildlife Service, Wyoming Ecological Services Field Office

Protections for Raptors

Raptors, or birds of prey, and the majority of other birds in the United States are protected by the Migratory Bird Treaty Act, 16 U.S.C. 703 (MBTA). A complete list of migratory bird species can be found in the Code of Federal Regulations at 50 CFR 10.13. Eagles are also protected by the Bald and Golden Eagle Protection Act, 16 U.S.C. 668 (Eagle Act).

The MBTA protects migratory birds, eggs and nests from possession, sale, purchase, barter, transport, import, export, and take. The regulatory definition of take, defined in 50 CFR 10.12, means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to hunt, shoot, wound, kill, trap, capture, or collect a migratory bird. Activities that result in the unpermitted take (e.g., result in death, possession, collection, or wounding) of migratory birds or their eggs are illegal and fully prosecutable under the MBTA. Removal or destruction of active nests (i.e., nests that contain eggs or young), or causing abandonment of an active nest, could constitute a violation of the MBTA, the Eagle Act, or both statutes. Removal of any active migratory bird nest or any structure that contains an active nest (e.g., tree) where such removal results in take is prohibited. Therefore, if nesting migratory birds are present on or near a project area, project timing is an important consideration during project planning. As discussed below, the Eagle Act provides additional protections for bald and golden eagles and their nests. For additional information concerning nests and protections under the MBTA, please see the U.S. Fish and Wildlife Service's (Service) Migratory Bird Permit Memorandum, MBMP-2.

The Service's Wyoming Ecological Services Field Office works to raise public awareness about the possible occurrence of birds in proposed project areas and the risk of violating the MBTA, while also providing guidance to minimize the likelihood that take will occur. We encourage you to coordinate with our office before conducting actions that could lead to the take of a migratory bird, their young, eggs, or active nests (e.g., construction or other activity in the vicinity of a nest that could result in a take). If nest manipulation is proposed for a project in Wyoming, the project proponent should also contact the Service's Migratory Bird Office in Denver at 303-236-8171 to see if a permit can be issued. Permits generally are not issued for an active nest of any migratory bird species, unless removal of the nest is necessary for human health and safety. If a permit cannot be issued, the project may need to be modified to ensure take of migratory birds, their young or eggs will not occur.

For infrastructure (or facilities) that have potential to cause direct avian mortality (e.g., wind turbines, guyed towers, airports, wastewater disposal facilities, transmission lines), we recommend locating structures away from high avian-use areas such as those used for nesting, foraging, roosting or migrating, and the travel zones between high-use areas. If the wildlife survey data available for the proposed project area and vicinity do not provide the detail needed to identify normal bird habitat use and movements, we recommend collecting that information prior to determining locations for any infrastructure that may create an increased potential for avian mortalities. We also recommend contacting the Service's Wyoming Ecological Services office for project-specific recommendations.

Additional Protections for Eagles

The Eagle Act protections include provisions not included in the MBTA, such as the protection of unoccupied nests and a prohibition on disturbing eagles. Specifically, the Eagle Act prohibits knowingly taking, or taking with wanton disregard for the consequences of an activity, any bald or golden eagle or their body parts, nests, chicks or eggs, which includes collection, possession, molestation, disturbance, or killing. The term "disturb" is defined as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (50 CFR 22.3 and see also 72 FR 31132).

The Eagle Act includes limited exceptions to its prohibitions through a permitting process. The Service has issued regulations concerning the permit procedures for exceptions to the Eagle Act's prohibitions (74 FR 46836), including permits to take golden eagle nests which interfere with resource development or recovery operations (50 CFR 22.25). The regulations identify the conditions under which a permit may be issued (i.e., status of eagles, need for action), application requirements, and other issues (e.g., mitigation, monitoring) necessary in order for a permit to be issued.

For additional recommendations specific to Bald Eagles please see our Bald Eagle information web page (http://www.fws.gov/wyominges).

Recommended Steps for Addressing Raptors in Project Planning
Using the following steps in early project planning, agencies and proponents can more easily minimize impacts to raptors, streamline planning and permitting processes, and incorporate measures into an adaptive management program:

1. Coordinate with appropriate Service offices, Wyoming Game and Fish Department, Tribal governments, and land-management agencies at the earliest stage of project planning.
2. Identify species and distribution of raptors occurring within the project area by searching existing data sources (e.g., Wyoming Game and Fish Department, Federal land-management agencies) and by conducting on-site surveys.
3. Plan and schedule short-term and long-term project disturbances and human-related activities to avoid raptor nesting and roosting areas, particularly during crucial breeding and wintering periods
4. Determine location and distribution of important raptor habitat, nests, roost sites, migration zones and, if feasible, available prey base in the project impact area.
5. Document the type, extent, timing, and duration of raptor activity in important use areas to establish a baseline of raptor activity.
6. Ascertain the type, extent, timing, and duration of development or human activities proposed to occur, and the extent to which this differs from baseline conditions.
7. Consider cumulative effects to raptors from proposed projects when added to past, present, and reasonably foreseeable actions. Ensure that project mitigation adequately addresses cumulative effects to raptors.
8. Minimize loss of raptor habitats and avoid long-term habitat degradation. Mitigate for unavoidable losses of high-valued raptor habitats, including (but not limited to) nesting, roosting, migration, and foraging areas.
9. Monitor and document the status of raptor populations and, if feasible, their prey base post project completion, and evaluate the success of mitigation efforts.
10. Document meaningful data and evaluations in a format that can be readily shared and incorporated into wildlife databases (contact the Service's Wyoming Ecological Services office for details).

Protection of nesting, wintering (including communal roost sites), and foraging activities is considered essential to conserving raptors. In order to promote the conservation of migratory bird populations and their habitats, Federal agencies should implement those strategies directed by Executive Order 13186, "Responsibilities of Federal Agencies To Protect Migratory Birds" (66 FR 3853).

Recommended Seasonal and Spatial Buffers to Protect Nesting Raptors
Because many raptors are particularly sensitive to disturbance (that may result in take) during the breeding season, we recommend implementing spatial and seasonal buffer zones to protect individual nest sites/territories (Table 1). The buffers serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees. The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where

there is little or no forested or topographical separation, distance alone must serve as the buffer. Adequate nesting buffers will help ensure activities do not take breeding birds, their young or eggs. For optimal conservation benefit, we recommend that no temporary or permanent surface occupancy occur within species-specific spatial buffer zones. For some activities with very substantial auditory impacts (e.g., seismic exploration and blasting) or visual impacts (e.g., tall drilling rig), a larger buffer than listed in Table 1 may be necessary, please contact the Service's Wyoming Ecological Services office for project specific recommendations on adequate buffers.

As discussed above, for infrastructure that may create an increased potential for raptor mortalities, the spatial buffers listed in Table 1 may not be sufficient to reduce the incidence of raptor mortalities (for example, if a wind turbine is placed outside a nest disturbance buffer, but inadvertently still within areas of normal daily or migratory bird movements); therefore, please contact the Service's Wyoming Ecological Services office for project specific recommendations on adequate buffers.

Buffer recommendations may be modified on a site-specific or project-specific basis based on field observations and local conditions. The sensitivity of raptors to disturbance may be dependent on local topography, density of vegetation, and intensity of activities. Additionally, individual birds may be habituated to varying levels of disturbance and human-induced impacts. Modification of protective buffer recommendations may be considered where biologically supported and developed in coordination with the Service's Wyoming Ecological Services Field Office.

Because raptor nests are often initially not identified to species (e.g., preliminary aerial surveys in winter), we first recommend a generic raptor nest seasonal buffer guideline of January 15^{th} – August 15^{th}. Similarly, for spatial nesting buffers, until the nesting species has been confirmed, we recommend applying a 1-mile spatial buffer around the nest. Once the raptor species is confirmed, we then make species-specific and site-specific recommendations on seasonal and spatial buffers (Table 1).

Activities should not occur within the spatial/seasonal buffer of any nest (occupied or unoccupied) when raptors are in the process of courtship and nest site selection. Long-term land-use activities and human-use activities should not occur within the species-specific spatial buffer of occupied nests. Short-term land use and human-use activities proposed to occur within the spatial buffer of an occupied nest should only proceed during the seasonal buffer after coordination with the Service, State, and Tribal wildlife resources management agencies, and/or land-management agency biologists. If, after coordination, it is determined that due to human or environmental safety or otherwise unavoidable factors, activities require temporary incursions within the spatial and seasonal buffers, those activities should be planned to minimize impacts and monitored to determine whether impacts to birds occurred. Mitigation for habitat loss or degradation should be identified and planned in coordination with applicable agencies.

Please contact the Service's Wyoming Ecological Services Field Office if you have any questions regarding the status of the bald eagle, permit requirements, or if you require technical assistance regarding the MBTA, Eagle Act, or the above recommendations. The recommended spatial and seasonal buffers are voluntary (unless made a condition of permit or license) and are not regulatory, and they do not supersede provisions of the MBTA, Eagle Act, Migratory Bird Permit Memorandum (MBMP-2), and Endangered Species Act. Assessing legal compliance with the MBTA or the Eagle Act and the implementing regulations is ultimately the authority and responsibility of the Service's law enforcement personnel. Our recommendations also do not supersede Federal, State, local, or Tribal regulations or permit conditions that may be more restrictive.

Table 1. Service's Wyoming Ecological Services Field Office's Recommended Spatial and Seasonal Buffers for Breeding Raptors

Raptors of Conservation Concern (see below for more information)

Common Name	Spatial buffer (miles)	Seasonal buffer
Golden Eagle	0.5	January 15 - July 31
Ferruginous Hawk	1	March 15 - July 31
Swainson's Hawk	0.25	April 1 - August 31
Bald Eagle	see our Bald Eagle information web page	
Prairie Falcon	0.5	March 1 - August 15
Peregrine Falcon	0.5	March 1 - August 15
Short-eared Owl	0.25	March15- August 1
Burrowing Owl	0.25	April 1 – September 15
Northern Goshawk	0.5	April 1 - August 15

Additional Wyoming Raptors

Common Name	Spatial buffer (miles)	Seasonal buffer
Osprey	0.25	April 1 - August 31
Cooper's Hawk	0.25	March 15 – August 31
Sharp-shinned Hawk	0.25	March 15 – August 31
Red-tailed Hawk	0.25	February 1 – August 15
Rough-legged Hawk (winter resident only)	----	----
Northern Harrier	0.25	April 1 - August 15
Merlin	0.5	April 1 - August 15
American Kestrel	0.125	April 1 – August 15
Common Barn Owl	0.125	February 1 – September 15
Northern Saw-whet Owl	0.25	March 1 - August 31
Boreal Owl	0.25	February 1 – July 31
Long-eared Owl	0.25	February 1 – August 15
Great Horned Owl	0.125	December 1 – September 30
Northern Pygmy-Owl	0.25	April 1 – August 1
Eastern Screech -owl	0.125	March 1 – August 15
Western Screech-owl	0.125	March 1 – August 15
Great Gray Owl	0.25	March 15 – August 31

Raptors of Conservation Concern

The Service's Birds of Conservation Concern (2008) report identifies "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing" under the Endangered Species Act (16 U.S.C 1531 et seq.). This report is intended to stimulate coordinated and proactive conservation actions among Federal, State, and private partners. The Wyoming Partners in Flight Wyoming Bird Conservation Plan identifies priority bird species and habitats, and establishes objectives for bird populations and habitats in Wyoming. This plan also recommends conservation actions to accomplish the population and habitat objectives.

We encourage project planners to develop and implement protective measures for the Birds of Conservation Concern as well as other high-priority species identified in the Wyoming Bird Conservation

Plan. For additional information on the Birds of Conservation Concern that occur in Wyoming, please see our Birds of Conservation Concern web page.

Additional Planning Resources

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

Edison Electric Institute and the Raptor Research Foundation. 1996. Suggested Practices for Raptor Protection on Power Lines - The State of the Art in 1996. Washington, D.C.

Edison Electric Institute's Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service. 2005. Avian Protection Plan Guidelines.

Edison Electric Institute and the Raptor Research Foundation. 1994. Mitigating Bird Collisions with Power Lines - The State of the Art in 1994. Washington, D.C.

U.S. Fish and Wildlife Service. 2000. Siting, Construction, Operation and Decommissioning of Communications Towers and Tower Site Evaluation Form (Directors Memorandum September 14, 2000). Arlington, Virginia.

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. United States Department of Interior, Fish and Wildlife Service, Arlington, Virginia. 23 pp.

Wyoming Game and Fish Department Internet Link to Raptor Information

References

50 CFR 10.12 – Code of Federal Regulations. Title 50--Wildlife and Fisheries, Chapter I--United States Fish and Wildlife Service, Department of the Interior, Part 10--General Provisions.

50 CFR 10.13– Code of Federal Regulations. Title 50--Wildlife and Fisheries. Chapter I--United States Fish and Wildlife Service, Department of the Interior, Part 10--General Provisions.

50 CFR 22.3 – Code of Federal Regulations. Title 50--Wildlife and Fisheries, Chapter I--United States Fish and Wildlife Service, Department of the Interior, Part 22—Eagle Permits.

50 CFR 22.25– Code of Federal Regulations. Title 50--Wildlife and Fisheries, Chapter I--United States Fish and Wildlife Service, Department of the Interior, Part 22—Eagle Permits.

66 FR 3853 - Presidential Documents. Executive Order 13186 of January 10, 2001. Responsibilities of Federal Agencies To Protect Migratory Birds. Federal Register, January 17, 2001.

72 FR 31132 - Protection of Eagles; Definition of "Disturb". Final Rule. Federal Register, June 5, 2007.

74 FR 46836 - Eagle Permits; Take Necessary To Protect Interests in Particular Localities. Final Rule. Federal Register, September 11, 2009.

U.S. Fish and Wildlife Service. 2003. Migratory Bird Permit Memorandum, MBMP-2, Nest Destruction (Directors Memorandum April 15, 2003). Washington, D.C.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp.

Bald Eagle (*Haliaeetus leucocephalus*)

Wyoming Distribution (Nesting) by County: **Albany, Big Horn, Campbell, Carbon, Converse, Fremont, Goshen, Hot Springs, Johnson, Laramie, Lincoln, Natrona, Niobrara, Park, Platte, Sheridan, Sublette, Sweetwater, Teton, Uinta, Washakie, Weston**

The U.S. Fish and Wildlife Service (Service) removed the bald eagle, except in portions of Arizona, from the list of threatened and endangered species under the Endangered Species Act (16 U.S.C 1531 et seq.). However, the protections provided to the bald eagle under the Migratory Bird Treaty Act, 16 U.S.C. 703 (MBTA), and the Bald and Golden Eagle Protection Act, 16 U.S.C. 668 (Eagle Act) remain in place. The term "disturb" under the Eagle Act is defined as: "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (72 FR 31332).

Adult eagles establish life-long pair bonds and build large nests in the tops of large trees near rivers, lakes, marshes, or other wetland areas. During winter, bald eagles gather along open water to forage and night roost in large mature trees, usually in secluded locations that offer protection from harsh weather. Bald eagles often return to use the same nest and winter roost year after year.

Habitat loss and human disturbance remain as potential threats to the bald eagle's continued recovery. Because bald eagles are particularly sensitive to human disturbance at their nests and communal roosts, protective buffers are needed around these areas.

The Service has developed National Bald Eagle Management Guidelines to advise land managers when and under what circumstances the protective provisions of the MBTA and Eagle Act may apply to their activities. Please note that in more open habitats typical to Wyoming, in addition to the general recommendation in the national guidelines, additional conservation recommendations may also be necessary (our Wyoming specific recommendation are described below).

For infrastructure (or facilities) that have increased potential to cause eagle mortality (e.g., wind turbines, guyed towers, airports, waste water disposal facilitates, transmission lines, etc.), we recommend locating the infrastructure outside of areas with high levels of eagle use (i.e., away from areas used for nesting, foraging, roosting or migrating) and outside of eagle travel corridors between such high-use areas. If the wildlife survey data available for the proposed project area and vicinity do not provide the detail needed to determine normal bird habitat use and movements, we recommend collecting that information prior to determining locations for infrastructure with increased potential for causing eagle mortalities. We also recommend contacting the Service's Wyoming Ecological Services office for project specific recommendations.

When the proposed infrastructure and facilities do not pose an increased risk of direct mortality, we recommend using the following general guidelines for work within Wyoming in order to avoid disturbing eagles and adequately protecting their habitat:

1. Conduct surveys within 0.5 mile of proposed activity for eagle nests and/or roosts during the appropriate time of year. Contact the Service's Ecological Services Wyoming Field Office if your project will occur within 0.5 mile of a known nest or roost to determine the potential impact of your activity to nesting and/or roosting bald eagles.

2. Avoid project-related disturbance and habitat alteration within 0.5-mile of bald eagle nests from the period of early courtship to post-fledging of chicks (January 1 through August 15).

3. Avoid disturbance within 0.5 mile of communal winter roosts from November 1 to April 1.

4. Avoid construction of above-ground structures within 0.5-mile of bald eagle nest sites and communal winter roost sites. Below ground structures (e.g., pipelines, buried power lines, fiber optic lines) may be sited closer as long as construction occurs outside of the active nesting or roosting season and will not result in the loss of alternate nest sites or roost trees.

A protective buffer for foraging areas (i.e., a linear length of river) will also be needed if the proposed activity may preclude use of foraging areas (e.g., extensive human activities on or near the water).

In Wyoming, the nesting season occurs from February 1 to August 15 and bald eagle nest buffers should receive full implementation during this time period. For some activities (construction, seismic exploration, blasting, and timber harvest), a larger buffer around the nest may be necessary.

Sensitivity to disturbance by roosting and nesting bald eagles may vary between individual eagles based on topography, density of vegetation, and intensity of activities. Modification of protective buffer recommendations may be considered where biologically supported and developed in coordination with the Service's Wyoming Ecological Services Field Office.

Please contact the Service's Wyoming Ecological Services Field Office if you have any questions regarding the status of the bald eagle, permit requirements, or if you require technical assistance regarding the MBTA, Eagle Act, or the above recommendations.

References

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. United States Department of Interior, Fish and Wildlife Service, Arlington, Virginia. 23 pp. [Online version available at <http://www.fws.gov/migratorybirds/>]

From: Scott Gamo [mailto:Scott.Gamo@wgf.state.wy.us]
Sent: Tuesday, December 14, 2010 9:46 AM
To: Jeff Winstead
Subject: Re: Cameco North Butte Wildlife Monitoring Plan

Jeff- I will try and get these back to you this week.

Scott Gamo
Staff Terrestrial Biologist
Habitat Protection Program
Wyoming Game and Fish
Cheyenne, WY 82006
Scott.Gamo@wgf.state.wy.us
307-777-4509

>>> "Jeff Winstead" <jeff@haydenwing.com> 12/7/2010 5:42 PM >>>
Scott

Attached is the Draft Wildlife Monitoring Plan for Cameco Resources' North Butte In-Situ Uranium Recovery Project in the Pumpkin Buttes area of Campbell County, Wyoming. Could you please review this and let me know if any modifications or additions are needed. This Monitoring Plan will be included with the Permit Update documents required by WDEQ-LQD.

I also emailed you on October 28 requesting an official letter from you listing the species of concern to WGFD. Have you had time to look at this? I have attached the request to this email. Cameco would also like to include this letter in their Permit Update documents to WDEQ-LQD.

Thank you for your time. Please feel free to call if you have any questions or need additional info.

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APPENDIX D10
PRE-MINING RADIOLOGICAL ASSESSMENT

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Please note: All tables and plates are located behind the tabs following this Appendix.

Tables

Plates

Addenda

APPENDIX D10
PRE-MINING RADIOLOGICAL ASSESSMENT

1.0 ENVIRONMENTAL BASELINE RADIOLOGICAL DATA

Uranerz prepared the original **Appendix D10** presented in this section. Power Resources, Inc. doing business as Cameco Resources (CR) has updated this section. Updated radiological information is presented in **Addendum D10-1**.

To characterize the baseline (pre-mining) radiological conditions at the North Butte ISL project site, a number of sampling programs were implemented. These included sampling programs for vegetation, soils and sediment, a gamma survey, thermoluminescent dosimetry (TLD), atmospheric radon-222, and air particulates. These baseline data are presented in the following sub-sections along with a description of the sampling program.

1.1 Concentrations in Vegetation

The North Butte permit area is rangeland used primarily for livestock grazing and wildlife habitat. Vegetation samples were collected at three locations (**Plate D10-1**) adjacent to the air monitoring sites during the month of June 1988. The samples were delivered to a commercial laboratory and analyzed for Th-230, Ra-226, Pb-210 and U(nat). The results of these analyses are presented in **Table D10-1**.

1.2 Concentrations in Soil

Radiological soil samples were collected at the three air monitoring sites (**Plate D10-1**). The samples were collected in increments of 0-5 cm, 5-10 cm, and 10-15 cm at each site and analyzed for Th-230, Ra-226, Pb-210 and U(nat). The results of these analyses are presented in **Table D10-2**.

Addendum D10-1 presents the results of verification soils sampling conducted by CR during 2010.

Soil samples will be collected along the "drainage where the surface discharge point will be located (**Plate D10-1**). Samples will be collected in increments of 0-5 cm and 5-15 cm upstream from the discharge point, at the discharge point and at two locations downstream, and analyzed for Ra-226 and U(nat). The results of these analysis will be presented prior to any construction activity at the site.

1.3 Concentrations in Sediment

Sediment samples were collected at two locations (**Plate D10-1**) on Willow Creek and from a small impoundment on the permit area as part of the pre-operational radiological sampling program. The two sample sites (SWS 1 and SWS 2) on

Willow Creek were located upstream and downstream of areas where run-off from the permit area enters the creek. The analyses for the sediment samples, which were analyzed for Th-230, Ra-226, Pb-210 and U(nat), are presented in **Table D10-3**.

1.4 Gamma Survey

The previous owners of the North Butte property had conducted a gamma survey over the entire permit area on a 500 foot grid system in 1979. Rather than conducting an entire new gamma survey, Uranerz elected to conduct a verification survey of 20 randomly selected points (**Plate D10-2**) to determine if an entirely new survey was warranted. At the randomly selected verification sample sites, a digital rate meter with a NaI(Tl) scintillation detector was used to determine the gamma levels. At each of the sites, three readings were taken and then averaged for the I uR/Hr reading. The mean gamma reading for the verification survey was 11.7 uR/Hr with a standard deviation of 0.56 uR/Hr. The gamma readings obtained during the verification survey were slightly lower than those obtained during the 1979 survey and were within a normal background range of 11 to 13 uR/Hr. The difference between the readings for the original and verifications surveys could be attributed to: different instrumentation, methodologies, soil moisture conditions and the fact that disturbances and drill hole cuttings on the ground surface were present, which have since been reclaimed and revegetated. Since the verification gamma readings were slightly lower than the 1979 readings, which were considered to be in a normal background range, it was determined that a new survey of the entire permit area was not warranted.

In addition to the verification gamma survey points, gamma readings were made at 10 background sites located away from the ore-bodies and at 19 sites where the plant facilities and evaporation ponds will be located. All gamma readings taken on the North Butte permit area are presented in **Table D10-4** and on **Plate D10-2**.

In conjunction with the gamma survey, surface soil samples were collected at all 20 verification sample sites. All 20 samples were analyzed for Ra-226 with 10 percent also being analyzed for Th-230, Pb-210 and U(nat). Surface soil samples were also collected at the ten background sites and at five of the plant facilities/evaporation pond sites and analyzed for Ra-226. The results of these analyses are presented in **Table D10-5**. An additional gamma survey will be conducted at the evaporation ponds locations prior to construction and prior to the synthetic liner being installed. **Addendum D10-1** presents the results of verification survey sampling conducted by CR during 2010.

1.5 Thermoluminescent Dosimetry

Gamma exposure rates were measured at six locations on and adjacent to the North Butte Property using TLDs which were changed on a quarterly basis. The TLD locations are shown on **Plate D10-1** and the results are presented in **Table D10-6**.

1.6 Atmospheric Radon-222

Atmosphere Rn-222 was monitored continuously at the same locations as the TLDs using passive Trak-Etch radon monitors. These monitors were quarterly basis at the same time that the TLDs were changed. Radon monitoring is presented in **Table D10-7**.

1.7 Air Particulates

Radiological air particulates were measured at three locations (**Plate D10-1**) using Hi-Volume air samplers. Samples were collected once each month with between 4,000 and 5,000 cubic meters of air passing through the samplers. The monthly samples were composited on a quarterly basis and analyzed for Th-230, Ra-226, Pb210 and U(nat). The results of this sampling program are presented in **Table D10-8**.

1.8 Concentrations in Ground Water

The water in the ore body aquifer (including "A", "B", "C", and "BC" sands) at the North Butte site contains naturally elevated levels of radium-226 based on the water quality sampling that has taken place. This condition is normal for aquifers in Wyoming containing significant uranium mineralization because of the complex geochemical environment. The radium-226 values from water samples collected in the ore body aquifer range from <0.2 to 82.4 pCi/L with an average of 6.51 pCi/L. The radium-226 values for each sampling event for each sampling well are presented in **Appendix D-6**. As individual mining units are base lined for water quality prior to mining, it is expected that some restoration sampling wells will have radium-226 concentrations significantly higher than 82.4 pCi/l.

The ore body aquifer also contains radon-222, which will be released above ground as a gas when the water coming from the well field is exposed to atmospheric pressure. No measurements of the radon-222 concentrations in the ore body aquifer have been made at the North Butte site; however, the values should be similar to other ISR projects in Wyoming. The operational procedures and monitoring program for safely dealing with the radon-222 gas released during mining is discussed later in <u>the Operations Plan</u>.

1.9 Concentrations in Surface Water

Surface water sampling points were established at three locations (**Plate D10-1**); Willow Creek upstream (SWS 1), Willow Creek downstream (SWS 2) and at a small impoundment (SWS 3).Throughout 1988, no water was observed in Willow Creek or the impoundment. Therefore no samples were collected for analysis. The year of 1988 was extremely dry in the central Powder River Basin. Water samples will be collected and analyzed in 1989, if possible, and the data will be forwarded to the DEQ and NRC.

2.0 RADIOLOGICAL IMPACT ON BIOTA OTHER THAN MAN

The in situ mining process being proposed for the North Butte facility is similar to the operation that was conducted and monitored during the Ruth Research and Development phase. The Ruth R & D operation was monitored for any and all potential releases to the environment for over two years with no radiological impacts on any biota including man. The proposed operations for commercial mining have incorporated basically all of the same operational procedures except that the product shipped from the site will be in a dried form.

The operationally proven techniques and experience of the company will be used to insure that the potential for any accidents or spills can be eliminated or minimized.

3.0 RADIOLOGICAL IMPACT ON MAN RADON 22

This section has been deleted as it is NRC specific for MILDOS and is not required by LQD regulations.

4.0 AIRBORNE PARTICULATES

This section has been deleted as it is NRC specific for MILDOS and is not required by LQD regulations.

5.0 ATMOSPHERIC DISPERSION COMPUTER PROGRAM (MILDOS)

This section has been deleted as it is NRC specific for MILDOS and is not required by LQD regulations.

APPENDIX D10
PRE-MINING RADIOLOGICAL ASSESSMENT

List of Tables

Table D10-1 Pre-Operational Radiological Vegetation Samples

Sample Site	Th-230 uCi/kg (x 10^{-5})	Ra-226 uCi/kg (x 10^{-5})	Pb-210 uCi/kg (x 10^{-5})	U(nat) mg/kg
NB 8	0.09±0.37	0.09±1.30	0.32±0.96	0.0535
NB 10	0.00±0.19	0.00±1.10	0.00±0.52	0.0444
NB 12	0.21±0.42	4.30±1.60	0.89±0.94	0.0444

Table D10-2 Pre-Operational Radiological Soil Samples

Sample Site	Depth	Th-330 (pCi/g)	Ra-226 (pCi/g)	Pb-210 (pCi/g)	U(nat) (pCi/g)
NB 8					
	0-5 cm	0.07±0.32	2.07±1.27	1.16±1.28	2.03
	5-10 cm	0.00±0.32	0.00±1.18	0.00±1.30	1.96
	10-15 cm	0.06±0.32	1.66±1.26	0.86±1.22	2.20
NB 10					
	0-5 cm	0.22±0.34	2.20±1.28	1.15±1.31	3.21
	5-10 cm	0.00±0.32	0.00±1.04	0.25±1.23	2.71
	10-15 cm	0.00±0.33	0.00±1.10	0.22±1.26	3.05
NB 12					
	0-5 cm	0.26±0.35	1.57±1.26	0.85±1.25	3.25
	5-10 cm	0.21±0.35	0.13±1.21	0.26±1.30	3.38
	10-15 cm	0.24±0.34	1.47±1.25	0.67±1.21	3.38

Table D10-3 Pre-Operational Radiological Sediment Samples

Sample Site	Th-230 (pCi/g)	Ra-226 (pCi/g)	Pb-210 (pCi/g)	U(nat) (pCi/g)
SWS 1	0.00±0.33	0.00±1.19	0.00±1.08	2.37
SWS 2	0.15±0.36	1.26±1.25	0.45±1.22	2.37
SWS 3	0.16±0.36	1.16±1.24	1.31±1.32	2.50

Table D10-4 Pre-Operational Verification Gamma Survey

Sample Point	Gamma (uR/Hr)	Sample Point	Gamma (uR/Hr)	Sample Point	Gamma (uR/Hr)
V-1	11	PF-1	11	B-1	12
V-2	11	PF-2	11	B-2	11
V-3	12	PF-3	11	B-3	11
V-4	12	PF-4	12	B-4	12
V-5	11	PF-5	12	B-5	11
V-6	12	PF-6	12	B-6	12
V-7	13	PF-7	12	B-7	11
V-8	12	PF-8	12	B-8	11
V-9	12	PF-9	11	B-9	12
V-10	12	PF-10	12	B-10	12
V-11	12	PF-11	12		
V-12	12	PF-12	12		
V-13	12	PF-13	11		
V-14	11	PF-14	12		
V-15	11	PF-15	12		
V-16	11	PF-16	11		
V-17	12	PF-17	12		
V-18	12	PF-18	12		
V-19	11	PF-19	11		
V-20	12				

Table D10-5 Pre-Operational Gamma Survey Surface Soil Samples

Sample Point	Th-230 (pCi/g)	Ra-226 (pCi/g)	Pb-210 (pCi/g)	U(nat) (pCi/g)
V-1		0.13±1.21		
V-2		0.88±1.26		
V-3		0.22±1.26		
V-4		0.69±1.23		
V-5		1.01±1.24		
V-6		1.47±1.25		
V-7		1.29±1.25		
V-8		0.94±1.24		
V-9	0.08±0.35	0.75±1.23	0.00±1.31	1.59
V-10		0.03±1.21		
V-11		1.29±1.25		
V-12		0.35±1.22		
V-13	0.12±0.37	0.63±1.23	0.00±1.27	2.44
V-14		0.00±1.19		
V-15		0.00±1.21		
V-16		0.00±1.18		
V-17		0.57±1.22		
V-18		1.22±1.24		
V-19		0.91±1.23		
V-20		0.00±1.20		
PF-2		0.00±1.18		
PF-5		0.50±1.22		
PF-6		2.10±1.27		
PF-12		0.13±1.21		
PF-15		0.63±1.23		
B-1		0.85±1.23		
B-2		0.91±1.23		
B-3		0.00±1.20		
B-4		0.00±1.20		
B-5		0.00±1.18		
B-6		0.00±1.20		
B-7		0.00±1.20		
B-8		1.04±1.24		
B-9		1.07±1.24		
B-10		0.47±1.22		

Table D10-6 Thermoluminescent Dosimetry

Sample Site	Gamma Exposure Rates			
	1st Quarter 12/87-03/31		2nd Quarter 03/31-6/30	
	Ave. MREM±SD	MREM/wk	Ave. MREM±SD	MREM/wk
NB 8	21.9 ± 4.0	2.04	33.6 ± 2.0	1.94
NB 9	34.4 ± 13.5	2.19	32.4 ± 2.7	1.87
NB 10	32.8 ± 9.5	2.09	34.4 ± 11.4	1.99
NB 11	30.6 ± 11.7	1.95	31.2 ± 3.3	1.80
NB 12	36.0 ± 8.6	2.29	34.0 ± 5.3	1.97
NB 13	32.0 ± 5.1	2.04	33.6 ± 7.3	1.94
Control	27.8 ± 2.2	1.77	34.6 ± 6.4	2.00
	3rd Quarter 6/30-9/30		4th Quarter 10/01-12/31	
NB 8	LOST		37.2 ± 13.3	1.91
NB 9	40.8 ± 7.4	2.16	37.2 ± 18.5	1.91
NB 10	38.2 ± 11.4	2.03	33.4 ± 1.1	1.72
NB 11	39.8 ± 9.9	2.11	33.4 ± 4.8	1.72
NB 12	41.6 ± 7.2	2.21	38.0 ± 19.3	1.96
NB 13	LOST		LOST	
Control	39.4 ± 7.9	2.09	34.8 ± 2.2	1.79

Table D10-7 Radon-222 Concentrations

Sample Site	Gamma Exposure Rates			
	1st Quarter 01/06/88-03/31/88		2nd Quarter 03/31/88-06/30/88	
	Ave. Radon Conc. (pCi/l)	% Std. Dev.	Ave. Radon Conc. (pCi/l)	% Std. Dev.
NB 8	0.6	21.8	2.0	18.0
NB 9	0.4	37.8	0.8	19.6
NB 10	0.4	35.4	1.1	19.6
NB 11	0.4	28.9	0.5	23.6
NB 12	0.7	20.9	1.1	19.6
NB 13	0.7	20.9	1.0	20.0
	4th Quarter 06/30/88 – 09/30/88		4th Quarter 09/30/88 – 01/03/89	
	Ave. Radon Conc. (pCi/l)	% Std. Dev.	Ave. Radon Conc. (pCi/l)	% Std. Dev.
NB 8	0.5	23.6	1.0	17.4
NB 9	0.6	22.4	0.6	21.8
NB 10	0.8	18.6	0.5	22.9
NB 11	0.3	33.3	1.1	16.9
NB 12	0.8	18.9	0.7	20.4
NB 13	1.9	17.7	0.5	24.3

Table D10-8 Pre-Operational Radiological Air Particulates

Sample Site	Th-2330 (pCi/m^3)	Ra-226 (pCi/m^3)	Pb-210 (pCi/m^3)	U(nat) (mg/m^3)
First Quarter (Jan, Feb, Mar 1988)				
NB 8	0.15±0.52E-4	1.67±0.31E-4	1.41±2.03E-4	1.43E-6
NB 10	0.37±0.51E-4	1.15±0.28E-4	0.80±2.01E-4	1.43E-6
NB 12	0.37±0.46E-4	0.53±0.23E-4	0.47±2.18E-4	1.66E-6
Second Quarter (Apr, May, Jun 1988)				
NB 8	0.66±0.62E-4	2.60±0.60E-4	1.58±2.39E-4	2.58E-6
NB 10	1.09±0.92E-4	3.26±0.55E-4	2.73±2.46E-4	3.11E-6
NB 12	0.52±0.50E-4	2.67±0.52E-4	1.91±2.27E-4	1.70E-6
Third Quarter (Jul, Aug, Sep 1988)				
NB 8	0.09±0.81E-4	1.10±0.32E-4	0.59±1.98E-4	3.19E-7
NB 10	0.85±0.67E-4	1.13±0.26E-4	0.75±2.22E-4	2.78E-5
NB 12	0.62±0.56E-4	1.66±0.49E-4	0.98±2.06E-4	1.10E-6
Fourth Quarter (Oct, Nov, Dec 1988)				
NB 8	0.21±0.59E-4	3.54±1.71E-4	0.29±1.95E-4	3.66E-7
NB 10	0.37±0.55E-4	4396±2.09E-4	0.07±2.00E-4	3.31E-7
NB 12	0.44±0.05E-4	8.65±3.11E-4	0.51±2.37E-4	3.46E-7

APPENDIX D10
PRE-MINING RADIOLOGICAL ASSESSMENT

List of Plates

The following 2 Drawings specifically referenced Appendix D10 Table of Contents have been processed into ADAMS.

These drawings can be accessed within the ADAMS package or by performing a search on the Document/Report Number.

D-215 to D-216

ADDENDUM D10-1
SUPPLEMENTAL GAMMA SURVEY

Table of Contents

Tables

Please note: All tables are located behind the tabs following this Addendum.

ADDENDUM D10-1
SUPPLEMENTAL GAMMA SURVEY

R and D Enterprises, Inc. (RDE), in conjunction with Lidstone and Associates, Inc. (LA) conducted a background gamma radiation survey on portions of Cameco Resources's (CR) North Butte ISR property. The survey was performed in order to:

- Confirm previous gamma radiation levels as determined by other firms using similar survey equipment dating to the mid-1980s
- Increase gamma survey densities in areas expected to be impacted by construction and future operations such as the process plant and evaporation pond locations.
- Expand the original survey area to include an expanded permit boundary and a proposed roadway.

The survey was conducted in two phases (06/30 and 07/15 2010) by John Lidstone (LA, providing surveyed gridded coordinates) and Roger and Sheryl Garling (RDE, providing gamma measurements and sample point selection and collection). LA provided a LEICA System 1200 GPS with Smart Rover and a four point local calibrations and base station to establish gamma reading locations and to guide the overall survey. A Ludlum Model 19 NaI scintillometer (Serial #53241, calibrated 12/16/2009) provided by CR was used to obtain gamma measurements at the survey points. A total of 423 gamma readings were recorded in the four selected areas. The plant and wellfield portions were surveyed on a ~50 foot transect interval, the proposed roadway at 150 foot intervals in the road center, and the additional permit area was covered by 50 to 550foot transect intervals. No specific features were encountered showing elevated gamma readings, including sandstone outcrops and drainages.

Since the survey was performed, the locations of the proposed access road and satellite building have changed. Additional data will need to be collected from the new locations prior to construction at the site.

Two soil sample locations were selected; survey points 1024 and 1099, plant and pond areas, respectively, with sample depths of 0 to 15 cm and 15to 30 cm which conforms to U.S. Nuclear Regulatory Commission (NRC) site reclamation criteria. Sample locations were selected based on the limited range of μR readings with one sample collected in moist sediment to attempt to locate any naturally occurring pre-mining elevated radiological concentrations. The samples were submitted to a qualified laboratory for the analytes listed in NRC Regulatory

Guide 4.14 (230Thorium, natUranium, 210Lead, 226Radium). Sample analysis data are provided in **Table D10-1.1**.

The gamma radiation field data collected included 423 points showing an overall mean of 15.06 μR/hr ± 0.80 μR/hr with a minimum reading of 12.5 μR/hr and a maximum of 20.0 μR/hr.

Field gamma readings collected in the mid-1980s were reported in a range for 11 to 13 μR/hr with an average of 11.7 ± 0.56 (standard deviation) μR/hr. Variation between the two different measurement events is within the field measurement equipment's manufacturing precision specification of ± 30%. Therefore it is concluded that the 2010 verification data agrees with the data collected in the mid-1980s. Radionuclide analyses of soil samples collected in 2010 from the top 15 cm were low and in general were consistent with the historical data. **Table D10-1.1** summarizes the data collected in the 1980s and in 2010.

ADDENDUM D10-1
SUPPLEMENTAL GAMMA SURVEY

List of Tables

Table D10-1.1North Butte ISL Project - Summary of Analytical Data - 2010

Sample Location	Depth	Field Gamma Reading		Lead 210	Radium 226	Thorium 230	Uranium
	cm	µR/hr @ 1 meter	µR/hr @ surface	pCi/g	pCi/g	pCi/g	mg/Kg (pCi/g)
1024 Survey Point	0-15	16	17	1.3 ± 0.5	0.6 ± 0.1	0.3 ± 0.2	0.77 (0.52)
	15-30	NA	NA	1.1 ± 0.5	0.6 ± 0.1	0.3 ± 0.2	0.72 (0.49)
1099 Survey Point	0-15	14	14.5	<1	0.6 ± 0.1	0.3 ± 0.2	0.48 (0.34)
	15-30	NA	NA	2.9 ± 0.5	1.5 ± 0.1	0.4 ± 0.2	1.37 (0.93)
Average 0-15				0.9	0.6	0.3	0.43
Standard Deviation 0-15				0.57	0	0	0.13

Baseline radiological assessment was first performed in the mid to late 1980s. Soil sample analyses reported in 1989 were:

Sample Location	Depth cm	Lead 210	Radium 226	Thorium 230	Uranium
	cm	pCi/g	pCi/g	pCi/g	pCi/g
NB 8	0-5	1.6 ± 1.28	2.07 ± 1.27	0.07 ±0.32	2.03
	5-10	0.00 ± 1.30	0.00 ± 1.18	0.00 ± 0.31	1.96
	10-15	0.89 ± 1.22	1.66 ± 1.26	0.06 ± 0.32	1.20
	Average 0-15	0.83 ± 1.27	1.24 ± 1.24	0.04 ± 0.32	1.73
	ST Deviation 0-15	0.80	1.10	0.38	0.46
NB 10	0-5	1.15 ± 1.31	2.20 ± 1.28	0.22 ± 0.34	3.21
	5-10	0.25 ± 1.23	0.00 ± 1.04	0.00 ± 0.32	2.71
	10-15	0.22 ± 1.26	0.00 ± 1.10	0.00 ± 0.33	3.05
	Average 0-15	0.54 ± 1.27	0.73 ± 1.14	0.07 ± 0.33	2.99
	ST Deviation 0-15	0.53	1.27	0.13	0.26
NB 12	0-5	0.85 ± 1.25	1.57 ± 1.26	0.26 ± 0.35	3.25
	5-10	0.26 ± 1.30	0.13 ± 1.21	0.21 ± 0.35	3.38
	10-15	0.67 ± 1.21	1.47 ± 1.25	0.24 ± 0.34	3.38
	Average 0-15	0.59 ± 1.25	1.06 ± 1.24	0.24 ± 0.35	3.34
	ST Deviation 0-15	0.30	0.80	0.03	0.08

APPENDIX D11
WETLANDS

Table of Contents

Please note: All attachments are located behind the tab following this Appendix.

Attachments

D11-1 Sample Point Photographs
D11-2 National Wetland Inventory Map with Sample Points
D11-3 Correspondence from the U.S. Army Corps of Engineers

APPENDIX D11
WETLANDS

1.0 DATA SOURCES

Cameco Resources (CR) proposes to update their existing #632 mine permit to proceed with in-situ uranium mining on the site. This mine permit area is within Campbell County and is approximately 20 miles west of the town of Wright. The claim is within Sections 13, 24, and 25 of R76N, T44N and Sections 18 and 19 of R75W, T44N.

2.0 GENERAL CONDITIONS

The permit area is on rolling terrain that becomes hilly as it approaches North Butte and the steep hillsides that rise up to the butte summit. The southern edge of the butte summit is approximately 0.15 mile northwest of the northern edge of the permit boundary. The site is dissected by several unnamed drainages that flow into Willow Creek, an ephemeral creek that flows from east to west across the very southern edge of the permit area. Willow Creek continues to the north and, within approximately 30 miles, flows into the Powder River.

Elevation on the site ranges from 5,500 feet as it nears the hillside of North Butte along the northern permit boundary, and dropping to 4,900 feet at Willow Creek at the southern edge of the permit area.

3.0 HABITAT DESCRIPTION

The North Butte permit area supports four vegetative community types including sagebrush-grassland, grassland, bottomland and juniper-sagebrush. A description of each community is provided in the vegetation section, **Appendix D8**. Sagebrush and sagebrush-grassland habitats are the primary habitats within the proposed disturbance area. These two habitat types form a mosaic across the hillsides. Grassland is also found in areas of previous exploratory drilling where reclamation has resulted in grass and forb establishment but with minimal sagebrush regeneration.

There has also been some disturbance due to previous coalbed methane exploration. Reclamation of these disturbance areas has been more recent than that associated with the uranium exploration drilling, not counting the drilling currently in progress associated with this proposed activity. The result is a dominance of reclaimed species such as wheatgrasses and yellow sweetclover in these areas where the native species have not yet regenerated. While there are weedy species in the area, as described in **Appendix D8**, they are scattered through the area and are not particularly prevalent even in the reclaimed areas.

Two small stock reservoirs are present within the permit area. Both of these were inspected for potential wetland habitat and will be described in more detail in Section 5.3. Additionally, three old reservoir locations associated with previous mineral extraction development or for prior use with livestock grazing are present but all three lack evidence of recent water retention.

4.0 METHODS

Using procedures outlined in the *1987 COE Wetlands Delineation Manual* (COE 1987) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (December 2006)*, Amber Travsky, a biologist with Real West Natural Resource Consulting, conducted a routine delineation with an on-site inspection on August 5 and 6, 2010. The results were submitted to the U.S. Army Corps of Engineers (ACOE) initially on October 29, 2010. Following discussion with ACOE personnel in mid-December 2010 additional soil data and drainage photographs were collected on December 28, 2010. The report was resubmitted with additional data information on January 4, 2011. The report was prepared using the following information and data collection.

4.1 Collection and Synthesis of Preliminary Data

Wetlands. Potential wetland locations were identified using National Wetlands Inventory (NWI) maps.

Aerial photography. Aerial photographs of the site were obtained from Google Earth and the Natural Resource Conservation Service (NCRS) Web site. Infrared photography of the site was obtained through the Wyoming Geographic Information Science Center (GISC) Imagery Server.

Hydrology. Site-specific hydrologic data was collected during the field surveys.

Vegetation. Site-specific vegetation data (e.g., dominant species) was recorded during the field surveys.

Soils. Soil classification was provided by the NRCS.

4.2 On-Site Wetland Delineation

A total of four sample points were analyzed for wetlands. A photograph of each sample point is in **Attachment D11-1** and the NWI map showing the sample points is in **Attachment D11-2**.

Plant communities and the dominant plant species within each community were identified at each sample point to determine the presence of hydrophytic vegetation. The predominance of hydrophytic vegetation, and subsequent determination of a wetland, was calculated using the 50/20 rule. Under the 50/20 rule, any plant species that equals or exceeds 20% of the total percent aerial coverage of the plot is a dominant plant. In addition, the cumulative total of all dominant plants must be equal to or greater than 50% of the aerial coverage of the plot. Plant dominance at each sample site was determined via ocular estimate of percent cover.

The *1986 Wetland Plant List - North Plains Region* (Reed 1986) was used to determine the indicator status of dominant plants within each community. Plant species were classified as obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), or upland (UPL) species.

On sites where hydric vegetation and hydrology suitable for sustaining wetlands was present, soil profiles were examined for hydric soil characteristics (e.g., mottling, gleying, and saturation) at potential wetland areas to determine if hydric soil indicators were present. Soil color was determined using Munsell Soil Color Charts (1994 Edition).

Geomorphic and hydrologic characteristics of the site were also investigated to determine if wetland hydrology was present.

All drainages that could be considered potential Waters of the U.S. were walked and photographed to provide the ACOE sufficient information to determine those drainages that qualify as jurisdictional.

5.0 RESULTS

Correspondence from the ACOE is in **Attachment D11-3**. Results from the wetland determination are presented below.

5.1 Preliminary Data Analysis

<u>National Wetland Inventory</u>

The National Wetland Inventory map (**Attachment D11-2**) indicates there are two patches of wetland habitat within the permit area boundary. The first, identified as a palustrine, emergent, temporarily flooded and diked or impounded (PEMAh) wetland is within a drainage on the southwestern edge of the permit area in the NW ¼ NW ¼ Section 25 (T44N, R76W). This wetland is Sample Point 1 in the description in Section 5.3. Another similar wetland is located in the NE ¼ NE ¼ Section 24 (T44N, R76W) and is Sample Point 4. A third wetland area is located just outside the permit area in the northwest corner. This wetland area, classified as palustrine, emergent and saturated, includes several seeps where the substrate is saturated to surface for an extended period during the growing season, but surface water is seldom present. These seeps are outside the permit area and will be unaffected by the proposed mining. Willow Creek, which is located near the southern border of the site, crosses the permit area for approximately 0.15 miles but the NWI map does not indicate it as a wetland in the portion that crosses the permit area.

Aerial Photography

A color aerial photograph was obtained through Google Earth. This photograph showed possible wetland areas along Willow Creek. The infrared photograph of the project area showed a few red tints, with red indicating wet areas, along the drainages but it did not indicate any significant wetlands within the permit area.

Soil Survey

The soil survey was provided by the NRCS via their Web Soil Site (NRCS 2010). All wetland sample points are within the soil map unit identified as Ustic Torriorthents, gullied. This soil type is characterized below.

233 – Ustic Torriorthents, gullied.

This soil type is found in gullies at slopes of 3 to 45 percent. The soil is well drained with the depth to water table more than 80 inches. The parent material is alluvium and/or residuum weathered from sandstone and shale. The typical soil profile has loam in the first four inches, loam at depths of 4 to 35 inches and bedrock at depths from 35 to 60 inches. Available water capacity is low.

5.2 Waters of the U.S.

Willow Creek likely qualifies as a Waters of the U.S. There was no flow in the creek during the wetland survey conducted on August 5, 2010 or during additional visits on June 17, July 6 and 7, and December 28, 2010. The creek bottom has a few patches of bare ground where water ponding likely occurs. There was some evidence of water flow, too, with drift marks in a few patches of the very bottom of the drainage. It is expected water is present only following precipitation events or early in the spring during years of high snow cover. While water was present in puddles further up the drainage from the road crossing, no creek flow was observed throughout its length across and immediately adjacent to the permit area.

Total length of all drainages within the permit area is 9.975 miles (52,669.9 feet). During the site surveys, the drainages lacked any flow but there are scattered areas of erosion in the form of cutbanks. Drift line and other evidence of water flow was lacking in the drainages.

5.3 Potential Jurisdictional Wetlands

Four sample points were examined during the August 2010 surveys. Drainage bottoms and the bottomland habitat identified in **Appendix D8** were closely inspected for additional wetland areas in addition to those sites identified in the NWI map. A summary of each sample point is given below.

Sample Point 1

This sample point is at a stock pond that is identified as a possible wetland area on the NWI map. Water was present in the pond during the August survey and covered approximately 0.05 acres. The immediate edge of the pond was bare ground and was heavily churned from livestock use, although livestock were not in the area at the time of the survey. The pond lacked emergent vegetation, as shown in **Attachment D11-1**, and supported only surface moss. The sample point is the vegetation abutting the bare ring around the stock pond to determine how much of the perimeter of the pond is wetland. The pond itself is open water and qualifies as a Waters of the U.S. since it holds water at least three months out of the year. The vegetation surrounding the pond is dominated by foxtail barley (65%) with western wheatgrass (25%) and curlycup gumweed (20%). Other species include bluegrasses, cheatgrass (*Bromus techtorum*) and green needlegrass. Due to the lack of sufficient hydrophytic species, the vegetation present adjacent to the pond is not hydrophytic and the area is not a wetland.

Sample Point 2

This sample point is in the drainage bottom in the southeast corner of the site but is not indicated as a wetland on the NWI map. In this area, the drainage bottom forms a gully, approximately 30 to 50 feet wide. In the lowest portion of the gully where wetland conditions are most likely, the vegetation is dominated by meadow foxtail (*Alopecurus pratensis*) and sandberg bluegrass (*Poa secunda*). While the meadow foxtail is a hydrophytic species (FACW), due to the lack of additional hydrophytic dominant vegetation species, the site is not a wetland. The vegetation does not meet the dominance test of having greater than 50% of the dominant species being hydrophytic. It likely has water gathering in the flatter portions of the drainage during spring run-off or following precipitation events, but the water containment is likely insufficient in duration to develop the site into a wetland.

Sample Point 3

This sample point was taken in the drainage bottom of Willow Creek and within the area of potential disturbance. The sample point is shown in **Attachment D11-1**. Willow Creek, as the access road crosses the drainage, is also shown in **Attachment D11-1**. The road crosses the creek over a culvert embankment approximately 300 yards east of the sample point. The vegetation in the creek bottom is dominated by Japanese brome (*Bromus japonicus*) with 60% coverage. Additional species, with less than the necessary 20% coverage to be considered dominant, are green needlegrass (*Stipa viridula*) and fringed sagebrush (*Artemisia frigida*). The soil lacked hydrophytic indicators and there were no wetland hydrologic indicators. While Willow Creek may have flow or low areas where ponding occurs at other points along its length, the creek bottom lacks wetland characteristics in the segment of proposed disturbance that crosses the permit area.

Sample Point 4

This sample point, located in the southwest corner of the site, is indicated as a wetland on the NWI map. The sample point was taken on the north side of the access road, as shown in the photograph in **Attachment D11-1**. Vegetation on the site is dominated by cheatgrass (*Bromus techtorum*) and wheatgrass (*Agropyron smithii*). Neither of these species is hydrophytic; therefore the site lacks the vegetation to qualify as a wetland.

6.0 IMPACTS

The only wetland within the permit area and also within the proposed disturbance area is the small stock pond described under Sample Point 1. The wetland area consists only of the ponded area, covering approximately 0.05 acres. No other wetlands will be affected by the proposed mining.

7.0 LITERATURE CITED

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U.S. Fish and Wildlife Service. 1992. Classification of Wetlands and Deepwater Habitats of the United States. FWS.OBS-79/31. Originally printed in 1979.

U.S. Fish and Wildlife Service. 1987. National Wetland Inventory Map, Via Internet at: http://www.fws.gov/nwi/

APPENDIX D11
WETLANDS

List of Attachments

Sample Point 1 is a small stock pond in the eastern third of the permit area. Photo taken August 5, 2010.

The small stock pond at **Sample Point 1** lacks emergent vegetation due to heavy use by livestock. Photo taken August 5, 2010.

Sample Point 2 is in a drainage bottom in the southeast corner of the permit area.
Photo taken August 5, 2010.

Sample Point 3 is in the drainage bottom of Willow Creek.
Photo taken August 5, 2010.

Willow Creek, as photographed on June 17, 2010 where the access road crosses over the creek drainage, lacks creek flow except, possibly, following significant precipitation events. Photo taken July 7, 2010.

Sample Point 4 is in an area previously used as a stock pond in the southwest corner of the permit area. It has likely not contained water for a number of years and currently no long qualifies as a wetland. Photo taken August 5, 2010.

APPENDIX D11
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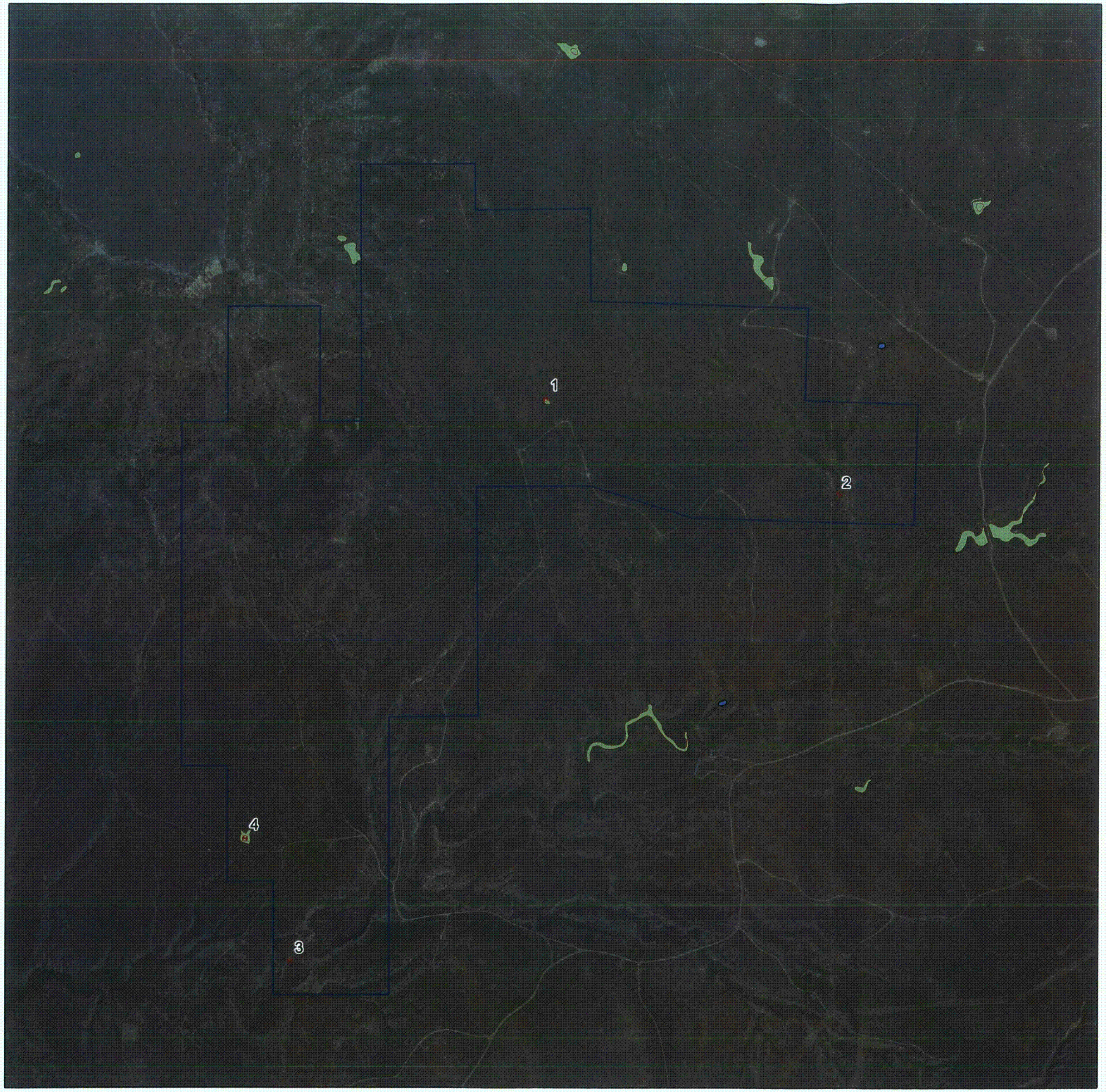

Legend

- NORTH BUTTE PERMIT BOUNDARY
- 1 WETLAND SAMPLE POINT
- Freshwater Emergent Wetland
- Freshwater Pond

2,000 0 2,000 Feet

N W E S

CAMECO

Cameco Resources
NORTH BUTTE ISR PROJECT
WDEQ PERMIT #632 UPDATE
Campbell Co., Wyoming

REVISIONS
NO. DATE. BY

Attachment D11-2
National Wetland Inventory Map with Sample Points

REV.

MAP INFO: This map was created from gis data provided from US Fish and Wildlife Service and Amber Travsky

FILENAME: WYCRE103_WETLAND_INVENTORY.MXD

APPENDIX D11
WETLANDS

List of Attachments

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
WYOMING REGULATORY OFFICE
2232 DELL RANGE BOULEVARD, SUITE 210
CHEYENNE WY 82009-4942

REPLY TO
ATTENTION OF

January 24, 2011

Wyoming Regulatory Office

Jean Lawlor
Cameco Resources
550 North Poplar Street, Suite 100
Casper, Wyoming 82601

Dear Ms. Lawlor:

This letter is in response to a request we originally received on November 2, 2010, from Real West Natural Resource Consulting (RW) on behalf of Cameco Resources, concerning verification of delineated aquatic sites at the North Butte ISR Uranium Project property west of Wright. Additional information was requested by our office and was received from RW on January 6, 2011. The North Butte Project area includes 1010 acres located in portions of Sections 13, 24, and 25, Township 44 North, Range 76 West, and Sections 18 and 19, Township 44 North, Range 75 West, Weston County, Wyoming.

The U.S. Army Corps of Engineers regulates the placement of dredged and fill material into waters of the United States under Section 404 of the Clean Water Act (33 U.S.C. 1344). The Corps' regulations are published in the *Code of Federal Regulations* as 33 CFR Parts 320 through 332. Detailed information on Section 404 requirements in Wyoming can be obtained from our website at: http://www.nwo.usace.army.mil/html/od-rwy/Wyoming.htm

We have reviewed the report titled *North Butte ISR Uranium Project Campbell County, Wyoming, Wetland Delineation Report*, dated January 2011 that documents aquatic resource delineation conducted by RW. Based on this report, we agree that the methods used to identify wetlands and other surface waters are consistent with the *Corps of Engineers Wetland Delineation Manual* (1987) and current supplements. Therefore, the report provides an accurate depiction of boundaries for all wetlands and other surface waters within the North Butte Project area, indentifying a total of 0.05 acre of wetland and open water, as shown in Figure A-2, and a total of 52,670 feet of surface drainage ways, identified in Figure A-5. This verification is valid for a period of 5 years, until **January 24, 2016**, unless new information warrants a modification.

Please understand that this letter provides verification of a wetland and other waters delineation only, which does not constitute an approved jurisdictional determination. An extensive evaluation in accordance with administrative procedures implemented by Headquarters of the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers on June 5, 2007, is now required before excluding or exerting jurisdiction over many streams and wetlands. The procedure is based primarily on rulings by the U.S. Supreme Court on January 9, 2001, in the case of *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* and on June 19, 2006, in the case of *Rapanos et ux., et al. v. United States*.

You may request an approved jurisdictional determination from our office; however, the administrative procedure described above is not necessary prior to undertaking activities authorized by nationwide permits such as utility line activities associated with ISR, as described by RW. On March 12, 2007, nationwide permits were published in Part II of the *Federal Register* (Vol. 72, No. 47). Those permits are available for a period of 5 years, currently until March 18, 2012. Information on nationwide permits is available from our website. Please refer to Nationwide Permit 12 concerning authorization of ISR activities. The permit may require a pre-construction notification as defined under General Condition 27 and stipulated under the notification section of the permit.

Thank you for your interest in cooperating with requirements of the U.S. Army Corps of Engineers' regulatory program. Please contact me at (307) 772-2300 if you have any questions and reference file NWO-2010-02765.

Sincerely,

Paige M. Wolken
Project Manager
Wyoming Regulatory Office

Copy Furnished

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