Nichols Ranch ISR Project U.S.N.R.C Source Material License Application

Volume VII

Appendices D7-D9

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APPENDIX D7:

SOIL ASSESSMENT

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LIST OF ABBREVIATIONS AND ACRONYMS

AMSL	Above mean sea level
ISR	In Situ Recovery
NRCS	Natural Resources Conservation Service
TRC	TRC Environmental Corporation
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WDEQ/LQD	Wyoming Department of Environmental Quality, Land Quality Division

D7.1.0 INTRODUCTION

The purpose of this report is to provide a detailed inventory of premine soil characteristics within the project area in accordance with Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) Guideline No. 1 (1994). The soils information presented in this appendix was collected in accordance with a Soils Baseline Study Plan for the Nichols Ranch ISR Project approved by WDEQ/LQD and TRC Environmental Corporation (TRC) in August 2006. The information in this appendix includes an inventory of soil types (soil map units) and soil series based on the Order 3 soil survey, a base map delineating the soil types, physical and chemical characteristics of the topsoil for potential disturbance areas, and estimated depths of salvageable topsoil from the potential disturbance areas for future reclamation purposes.

The Nichols Ranch ISR Project area is located in southwest Campbell County and southeast Johnson County approximately 46 mi southwest of Gillette, Wyoming. The project area includes two noncontiguous areas designated as the Nichols Ranch Unit and the Hank Unit. The Nichols Ranch ISR Project area includes a total of 3,370.53 acres; 1,120 acres within the Nichols Ranch Unit and 2,250.53 acres within the Hank Unit.

The project area is located within the 10- to 14-inch Northern Plains zone of northeastern Wyoming (Natural Resources Conservation Service [NRCS] 1988). Elevations range from 5,055 to 5,209 ft above mean sea level (AMSL) in the Hank Unit and from 4,670 to 4,900 ft AMSL in the Nichols Ranch Unit. Annual precipitation varies from 10 to 14 inches, with approximately 35-41% falling during the normal growing season. Growth of native cool-season plants begins about April 1 and continues to about July 1. Growth of native warm-season plants begins about May 15 and continues to about August 15 (NRCS 1988). According to Wyoming Gap data, two primary vegetation types occur in the project area; sagebrush shrubland and mixed grassland (Wyoming Gap Analysis 2000).

D7.2.0 METHODOLOGY

D7.2.1 LITERATURE REVIEW

The soils in the southern portions of Johnson and Campbell Counties were studied and mapped to an Order 3 scale by the NRCS in 1975 and 1991 respectively (NRCS 1975; 1991). Soils information for Southern Campbell County is available both electronically and in hard copy. However, soils information for Johnson County is only available in hard copy. The NRCS has also centralized dissemination of typical soil series descriptions and this information is available on the Internet at www.nrcs.usda.gov.

D7.2.2 PROJECT PARTICIPANTS

BKS Environmental Associates, Inc. of Gillette, Wyoming, performed the soil survey fieldwork and compiled a draft report. Energy Laboratories, Inc. of Casper, Wyoming, analyzed the soil samples, and TRC of Laramie, Wyoming, provided project direction and editing and quality assurance on the soils assessment report.

D7.2.3 SOIL SURVEY

All soils within the project area (including lands to be disturbed and all lands to be left undisturbed) were mapped to an Order 2 level. The soil maps for the project area were prepared in accordance with the techniques and procedures presented in the National Cooperative Soil Survey (U.S. Department of Agriculture [USDA] 1993), and all portions of this project adhered to procedures presented in WDEQ/LQD Guideline No. 1 (1994).

D7.2.4 SOIL SAMPLING

Because the proposed project involves the in situ recovery of uranium resources, WDEQ/LQD agreed that soil samples would only be collected from the disturbance areas associated with the two proposed plant areas (one in the Nichols Ranch Unit and one in the Hank Unit). The number

and location of samples are representative of the soil series that will be affected by the plant areas in the Nichols Ranch Unit and the Hank Unit.

Soil series were sampled and described by coring with a mechanical auger (i.e., truck-mounted Giddings). The physical and chemical nature of each horizon within the sampled profile was described and recorded in the field. Although numerous holes were augered for series and map unit verification, only the field locations of profiles selected for laboratory analysis are plotted on the soils map included with this report (see Exhibits D7-1 and D7-2). At least two quarts of sampled soil material were placed in clean, labeled, polyethylene plastic bags and kept cool to limit chemical changes. Due to the timing of the sample collection (i.e., December 2006), ambient air temperatures were not considered excessive and did not threaten the integrity of the samples or corresponding sample results. Samples were kept out of direct sunlight and transported promptly to Energy Laboratories for preparation and analysis.

D7.2.5 LABORATORY ANALYSIS

Following collection, the samples were prepared for chemical analysis and sample splits were collected and stored for possible future use. Laboratory analyses comply with the methodologies outlined in WDEQ/LQD Guideline No. 1 (1994).

D7.3.0 RESULTS AND DISCUSSION

D7.3.1 SOIL SURVEY - GENERAL

Topography of the area includes gently rolling hills and ridges, as well as steep terrain near North Middle Butte and eroded areas associated with Dry Willow Creek. The soils occurring in the Hank Unit and Nichols Ranch Unit are generally fine textured throughout with patches of sandy loam on upland areas and fine-textured soils occurring near or in drainages. The project area contains deep soils on lower toeslopes and flat areas near drainages with shallow and moderately deep soils located on upland ridges and shoulder slopes.

D7.3.2 SOIL MAPPING UNIT INTERPRETATION

The soil survey was conducted during the summer/fall of 2006 and covered the entire project area. All soils within the project area (including lands to be disturbed and all lands to be left undisturbed) were mapped to an Order 2 level. U.S. Geological Survey (USGS) topographic maps and aerial photos were projected to a scale of 1 inch = 500 ft and were used as the base map for the soil mapping effort. The results of the Order 2 soil mapping effort are presented as Exhibits D7-1 and D7-2. Both maps comply with the requirements of WDEQ/LQD Guideline No. 6 (2003). Soil map unit acreages within the project area, the Nichols Ranch Unit, and the Hank Unit are presented in Tables D7-1, D7-2, and D7-3, respectively.

Descriptions of mapping units and soil series are presented in Addendums D7A and D7B, respectively. Mapping unit and soil series descriptions presented in this appendix are consistent with the National Cooperative Soil Survey, and mapping unit descriptions are specific to the project area.

Table D7-1 Soil Map Units Within the Nichols Ranch ISR Project Area.

Soil Map Unit	Soil Map Unit Name	Project Area (Acres)	Percent (%)
102	Arvada, thick surface-Arvada Slickspots complex, 0-6 percent slopes	40.3	1.2
109	Bidman loam, 0-6 percent slopes	8.6	0.2
111-1	Bidman loam, 0-6 percent slopes	78.8	3.0
111-2	Parmleed loam, 0-6 percent slopes	26.2	0.8
121-1	Cushman loam, 0-6 percent slopes	36.3	1.1
121-2	Cambria loam, 0-6 percent slopes	40.2	1.2
124	Cushman-Shingle loams, 0-6 percent slopes	9.6	0.3
124-1	Cushman loam, 6-15 percent slopes	20.0	0.6
124-2	Shingle loam, 6-15 percent slopes	12.0	0.3
126-1	Cushman loam, 0-6 percent slopes	9.7	0.3
126-2	Theedle loam, 0-6 percent slopes	26.2	0.8
127-1	Cushman loam, 6-15 percent slopes	3.2	0.1
127-2	Theedle loam, 6-15 percent slopes	82.2	2.4
146-1	Forkwood loam, 0-6 percent slopes	124.8	3.6
146-2	Cushman loam, 0-6 percent slopes	130.3	3.8
147-1	Forkwood loam, 6-15 percent slopes	66.7	1.9
147-2	Cushman loam, 6-15 percent slopes	24.6	0.7
148-2	Ulm loam, 0-6 percent slopes	10.3	0.3
152	Haverdad-Clarkelen complex, 0-4 percent slopes	94.3	2.7
157-1	Hiland fine sandy loam, 0-6 percent slopes	140.0	4.1
157-2	Bowbac fine sandy loam, 0-6 percent slopes	89.9	2.6
158	Hiland-Bowbac fine sandy loams, 6-15 percent slopes	14.1	0.4
158-1	Hiland fine sandy loam, 6-15 percent slopes	48.8	1.4
158-2	Bowbac fine sandy loam, 6-15 percent slopes	88.2	2.6
170-1	Tullock loamy sands, 6-30 percent slopes	94.1	2.7
170-2	Tullock loamy sands, 6-30 percent slopes	129.2	3.7
171	Keeline-Tullock-Niobrara, dry complex, 3-30 percent slopes	21.4	0.6
180	Maysdorf-Pugsley sandy loams, 6-15 percent slopes	11.0	0.3
180-2	Pugsley sandy loams, 6-15 percent slopes	8.6	0.2
194	Pugsley-Decolney sandy loams, 6-15 percent slopes	32.1	0.9
194-1	Pugsley sandy loams, 6-15 percent slopes	44.2	1.3
194-2	Decolney sandy loams, 6-15 percent slopes	3.6	0.1

Table D7-1 (Continued)

Soil Map Unit	Soil Map Unit Name	Project Area (Acres)	Percent (%)
206	Samday-Shingle-Badland complex, 10-45 percent slopes	202.53	7.0
208-1	Savageton clay loam, 0-6 percent slopes	10.4	0.3
208-2	Silhouette clay loam, 0-6 percent slopes	26.8	0.8
211-1	Shingle loam, 3-30 percent slopes	4.8	0.1
211-2	Worf loam, 3-30 percent slopes	15.5	0.4
213-1	Terro sandy loam, 6-30 percent slopes	24.5	0.7
213-2	Taluce sandy loam, 6-30 percent slopes	4.1	0.1
216-1	Theedle loam, 3-30 percent slopes	27.6	0.8
216-2	Kishona loam, 3-30 percent slopes	272.4	7.9
216-3	Shingle loam, 3-30 percent slopes	30.4	0.9
217-1	Theedle loam, 3-30 percent slopes	156.4	4.5
217-2	Shingle loam, 3-30 percent slopes	143.3	5.7
227	Ulm-clay loam, 0-6 percent slopes	129.3	3.7
233	Ustic Torriorthents, gullied	392.5	11.4
HH	Haverson-Glenberg association	30.1	0.9
HK	Haverson-Glenberg association, saline	4.5	0.1
LO	Limon-Cadoma association, 0-10 percent slopes	27.7	0.8
MP-1	Maysdorf association, 6-15 percent slopes	24.7	0.7
MP-2	Pugsley association, 6-15 percent slopes	88.7	2.6
MR-1	Maysdorf association, 6-15 percent slopes	8.9	0.3
MR-2	Schooner association, 6-15 percent slopes	51.1	1.5
PXD-1	Pugsley complex, hilly, 6-15 percent slopes	19.4	0.6
PXD-2	Southfork complex, hilly, 6-15 percent slopes	20.8	0.6
STa-2	Arvada (Absted) complex, 0-3 percent slopes	11.1	0.3
STe-1	Stoneham association, 0-3 percent slopes	12.7	0.4
STe-2	Forkwood (Fort Collins) association, 0-3 percent slopes	22.7	0.7
	Total Acres	3,370.53	100.0

Table D7-2 Soil Map Units Within the Nichols Ranch Unit.

Soil Map Unit	Soil Map Unit Name	Acres
102	Arvada, thick surface-Arvada Slickspots complex, 0-6 percent slopes	40.3
121-1	Cushman loam, 0-6 percent slopes	6.9
124	Cushman-Shingle loams, 0-6 percent slopes	9.5
124-1	Cushman loam, 6-15 percent slopes	20.0
124-2	Shingle loam, 6-15 percent slopes	12.0
127-1	Cushman loam, 6-15 percent slopes	23.9
127-2	Theedle loam, 6-15 percent slopes	61.6
146-2	Cushman loam, 0-6 percent slopes	10.2
152	Haverdad-Clarkelen complex, 0-4 percent slopes	94.1
170-2	Keeline loamy sands, 6-30 percent slopes	11.6
171	Keeline-Tullock-Niobrara, dry complex, 3-30 percent slopes	21.4
180	Maysdorf-Pugsley sandy loams, 6-15 percent slopes	11.0
180-2	Pugsley sandy loams, 6-15 percent slopes	8.6
194-1	Pugsley sandy loams, 6-15 percent slopes	76.4
194-2	Decolney sandy loams, 6-15 percent slopes	3.6
208-1	Savageton clay loam, 0-6 percent slopes	10.4
208-2	Silhouette clay loam, 0-6 percent slopes	26.8
211-1	Shingle loam, 3-30 percent slopes	4.8
211-2	Worf loam, 3-30 percent slopes	15.5
216-1	Theedle loam, 3-30 percent slopes	27.6
216-2	Kishona loam, 3-30 percent slopes	46.1
216-3	Shingle loam, 3-30 percent slopes	30.6
217-1	Theedle loam, 3-30 percent slopes	36.5
217-2	Shingle loam, 3-30 percent slopes	143.3
233	Ustic Torriorthents, gullied	44.2
HH	Haverson-Glenberg association	30.2
HK	Haverson-Glenberg association, saline	4.7
LO	Limon-Cadoma association, 0-10 percent slopes	27.8
MP-1	Maysdorf association, 6-15 percent slopes	24.7
MP-2	Pugsley association, 6-15 percent slopes	88.9
MR-1	Maysdorf association, 6-15 percent slopes	8.9
MR-2	Schooner association, 6-15 percent slopes	51.2
PXD-1	Pugsley complex, hilly, 6-15 percent slopes	19.4
PXD-2	Southfork complex, hilly, 6-15 percent slopes	20.8
STa-2	Arvada (Absted) complex, 0-3 percent slopes	11.1
STe-1	Stoneham association, 0-3 percent slopes	12.7
STe-2	Forkwood (Fort Collins) association, 0-3 percent slopes	22.7
	Total Acres	1,120

Table D7-3 Soil Map Units Within the Hank Unit.

Map Unit ID	Name of Soil Map Unit	Acres
109	Bidman loam, 0-6 percent slopes	8.6
111-1	Bidman loam, 0-6 percent slopes	78.8
111-2	Parmleed loam, 0-6 percent slopes	26.2
121-1	Cushman loam, 0-6 percent slopes	29.2
121-2	Cambria loam, 0-6 percent slopes	40.2
126-1	Cushman loam, 0-6 percent slopes	9.7
126-2	Theedle loam, 0-6 percent slopes	26.2
146-1	Forkwood loam, 0-6 percent slopes	124.8
146-2	Cushman loam, 0-6 percent slopes	119.9
147-1	Forkwood loam, 6-15 percent slopes	66.7
147-2	Cushman loam, 6-15 percent slopes	24.6
148-2	Ulm loam, 0-6 percent slopes	10.3
157-1	Hiland fine sandy loam, 0-6 percent slopes	140.0
157-2	Bowbac fine sandy loam, 0-6 percent slopes	89.9
158	Hiland-Bowbac fine sandy loams, 6-15 percent slopes	14.1
158-1	Hiland fine sandy loam, 6-15 percent slopes	48.8
158-2	Bowbac fine sandy loam, 6-15 percent slopes	76.3
170-1	Keeline loamy sands, 6-30 percent slopes	94.1
170-2	Tullock loamy sands, 6-30 percent slopes	129.2
206	Samday-Shingle-Badland complex, 10-45 percent slopes	202.53
213-1	Terro sandy loam, 6-30 percent slopes	24.5
213-2	Taluce sandy loam, 6-30 percent slopes	4.1
216-2	Kishona loam, 3-30 percent slopes	226.2
217-1	Theedle loam, 3-30 percent slopes	119.9
217-2	Shingle loam, 3-30 percent slopes	38.3
227	Ulm-clay loam, 0-6 percent slopes	129.3
233	Ustic Torriorthents, gullied	348.0
	Total Acres	2,250.53

In accordance with NRCS recommendations, the following soil series have been renamed and the new names have been included in this Appendix:

- Absted loam has been changed to Arvada (thick surface) loam,
- Fort Collins loam has been changed to Forkwood loam,
- Olney sandy loam has been changed to Hiland sandy loam,
- Tassel sandy loam has been changed to Taluce sandy loam,
- Terry sandy loam has been changed to Terro sandy loam,
- Stoneham loam has been changed to Cambria loam, and
- Thedalund loam has been changed to Theedle loam.

D7.3.3 ANALYTICAL RESULTS

Since only a small portion of the project area will be disturbed by the ISR project, WDEQ/LQD directed that a representative number of samples be collected from the two plant site areas (one plant site is located in each unit). To provide siting flexibility of each plant, a 5-acre area (this is larger than the size of the actual plant disturbance) was designated and soil samples were collected. Based on this approach, a total of seven sample sites were designated for the plant sites located within the Nichols Ranch ISR Project area (four within the Nichols Ranch Unit and three within the Hank Unit) (refer to Table D7-4). The sample locations are illustrated in Exhibits D7-1 and D7-2, and the number and location of samples were representative of the mapping unit that will be affected. Energy Laboratories, Inc. analyzed all samples in accordance with WDEQ/LQD Guideline No. 1 (1994) and the results are presented in Addendum D7C. Laboratory soil texture analyses did not include percent fine sands; however, field observations of fine sands within individual profiles, as well as sample site topographic position, were used in conjunction with laboratory analytical results to determine series designation.

D7.3.4 EVALUATION OF SOIL SUITABILITY AS A PLANT GROWTH MEDIUM

General information about the topsoil samples collected from the two proposed plant sites is presented in Table D7-2. Total depths for all samples ranged from 57-60 inches and were

Table D7-2 General Soil Sample Information.[1]

Sample Site ID	Soil Unit	No. of sample intervals	Total Sample Depth (inches)
Nichols Ranch Unit Sample			
NNW	216-2	5	0 - 57
NNE	216-2	6	0 - 60
Nnorth	Ste-2	6	0 - 60
Nmiddle	Ste-2	6	0 - 60
Hank Unit Samples			
HNE	216-2	5	0 - 60
HNW	121-1	6	0 - 60
HSE	216-2	7	0 - 57

[1] Refer to Exhibits D7-1 and D7-2 for sample locations and Addendum D7C for a copy of the analytical results.

collected based on the appropriate soil profile. Based on the physical and analytical results presented in Addendum D7C, there are no factors that will limit the suitability of topsoil as a plant growth medium. All laboratory values were compared to Table I-2 of WDEQ/LQD Guideline No. 2 (1994) and the results were determined to be within the suitable range, except for marginal soil texture for four soil profiles from three samples collected in the Hank Unit. These four soil profiles were determined to have clay soil textures (refer to Addendum D7C).

D7.3.5 PRIME FARMLAND ASSESSMENT

Based on a reconnaissance survey conducted by NRCS, no prime farmland was identified within the Nichols Ranch ISR Project area (refer to Addendum D7D).

D7.4.0 REFERENCES

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ADDENDUM D7A:

SOIL MAPPING UNIT DESCRIPTIONS

ADDENDUM D7A

SOIL MAPPING UNIT DESCRIPTIONS

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D7A.1 102-Arvada, thick surface-Arvada-Slickspots complex, 0-6 percent slopes[1]

The Arvada, thick surface-Arvada-Slickspots complex map unit consists of very deep well-drained soils that developed from alluvium derived from sodic shale. It occurs on alluvial fans, fan terraces, fan remnants and hillslopes at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-53 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 70 percent Arvada thick surface and 10 percent Arvada Slickspots. Within this map unit, the following additional components are found: Bidman 5 percent, Felix ponded 5 percent, Keyner 5 percent, Ulm 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Arvada, thick surface-Arvada-Slickspots complex soil is slow, and the available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate to high (Slickspots), and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.2 109-Bidman loam, 0-6 percent slopes[1]

The Bidman loam map unit consists of very deep well-drained soils that developed from alluvium derived from calcareous shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-49 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 80 percent Bidman loam, 0 to 6 percent slopes. Within this map unit, the following additional components are found: Forkwood 6 percent, Ulm 6 percent, areas with 6 to10 percent slopes 5 percent, and Felix ponded 3 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bidman loam soil is slow, and the available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil with a potential stripping depth of 60 inches.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.3 111-Bidman-Parmleed loams, 0-6 percent slopes[1]

The Bidman-Parmleed loams map unit consists of moderately deep well-drained soils that developed from alluvium derived from calcareous shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-48 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Bidman loam and 30 percent Parmleed loam. Within this map unit, the following additional components are found: Forkwood 6 percent, Ulm 6 percent, Cushman 4 percent, and Felix ponded 4 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bidman-Parmleed loams soil is slow, and the available water capacity is low. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow to moderate, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.4 121-Cushman-Cambria loams, 0-6 percent slopes[1]

The Cushman-Cambria loams map unit consists of moderately deep well-drained soils that formed in residuum from shales and siltstones. It occurs on buttes, fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 40 percent Cushman loam and 35 percent Cambria loam. Within this map unit, the following additional components are found: Bowbac 5 percent, Forkwood 5 percent, Hiland 5 percent, and Kishona 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman-Cambria loams soil is moderate, and the available water capacity is moderate. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.5 124-Cushman-Shingle loams, 6-15 percent slopes[1]

The Cushman-Shingle loams map unit consists of moderately deep well-drained soils that developed in residuum from shales and siltstones. It occurs on buttes, fan remnants, hills, ridges, and terraces at elevations between 4,100 and 5,400 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 55 percent Cushman loam and 25 percent Shingle loam. Within this map unit, the following additional components are found: Theedle 5 percent, Worf 4 percent, Cambria 3 percent, Renohill 3 percent, Samday 2 percent, and areas of 3-6 percent slopes 3 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman-Shingle loams soil is moderate, and the available water capacity is low. The effective rooting depth is between 10 and 400 inches. Surface runoff is moderate, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information and also occurs in Johnson County.

D7A.6 126-Cushman-Theedle loams, 0-6 percent slopes[1]

The Cushman-Theedle loams map unit consists of moderately deep well-drained soils that developed in residuum from shale and sandstone. It occurs on buttes, fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 40 percent Cushman loam and 40 percent Theedle loam. Within this map unit, the following additional components are found: Cambria 5 percent, Kishona 5 percent, Renohill 4 percent, Shingle 4 percent, and slopes 6-10 percent 2 percent.

Permeability within the Cushman-Theedle loams soil is moderate, and the available water capacity is low. The effective rooting depth is between 20 and 40 inches. Surface runoff is slow to moderate, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.7 127-Cushman-Theedle loams, 6-15 percent slopes[1]

The Cushman-Theedle loams map unit consists of moderately deep well-drained soils that developed in residuum from shales and siltstones. It occurs on buttes, fan remnants, hills, ridges, and terraces at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Cushman loam and 30 percent Theedle loam. Within this map unit, the following additional components are found: Kishona 7 percent, Shingle 7 percent, and Cambria 7 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman-Theedle loams soil is moderate, and the available water capacity is low. The effective rooting depth is between 20 and 40 inches. Surface runoff is moderate to high, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.8 146-Forkwood-Cushman loams, 0 to 6 percent slopes[1]

The Forkwood-Cushman loams map unit consists of very deep well-drained soils that developed from alluvium. It occurs on alluvial fans, fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Forkwood loam and 30 percent Cushman loam. Within this map unit, the following additional components are found: Cambria 5 percent, Theedle 5 percent, Hiland 4 percent, Bowbac 3 percent, frequently ponded loamy soil 2 percent, and frequently ponded clayey soil 1 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Forkwood-Cushman loams soil is moderate, and the available water capacity is moderate to high. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.9 147-Forkwood-Cushman loams, 6-15 percent slopes[1]

The Forkwood-Cushman loams map unit consists of very deep well-drained soils that developed from alluvium. It occurs on alluvial fans, fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Forkwood loam and 30 percent Cushman loam. Within this map unit, the following additional components are found: Cambria 5 percent, Theedle 5 percent, Ulm 5 percent, and Zigweid 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Forkwood-Cushman loams soil is moderate, and the available water capacity is moderate to high. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.10 148-Forkwood-Ulm loams, 0-6 percent slopes[1]

The Forkwood-Ulm loams map unit consists of very deep well-drained soils that developed from alluvium. It occurs on alluvial fans, fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Forkwood loam and 35 percent Ulm loam. Within this map unit, the following additional components are found: Bidman 4 percent, Cambria 4 percent, Wyotite 4 percent, and Felix ponded 3 percent. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Forkwood-Ulm loams soil is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.11 152-Haverdad-Clarkelen complex, 0-4 percent slopes[1]

The Haverdad-Clarkelen complex map unit consists of very deep well-drained soils that developed from stratified alluvium on floodplains. It occurs on floodplains and terraces at elevations between 4,100 and 4,800 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-52 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 45 percent Haverdad soils and 35 percent Clarkelen soils. Within this map unit, the following additional components are found: Boruff 5 percent, Draknab 5 percent, Keeline 5 percent, and Kishona 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Haverdad-Clarkelen complex is moderate to moderately rapid, and the available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is low, the hazard of water erosion is slight, and the hazard of wind erosion is moderate to severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information and also occurs in Johnson County.

D7A.12 157-Hiland-Bowbac fine sandy loams, 0-6 percent slopes[1]

The Hiland-Bowbac fine sandy loams map unit consists of very deep well-drained soils that developed from alluvium on relict surfaces. It occurs on terraces, fans, fan remnants ridges, hills, and stabilized dunes at elevations between 4,100 and 5,300 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Hiland fine sandy loam and 30 percent Bowbac fine sandy loam. Within this map unit, the following additional components are found: Cushman 5 percent, Forkwood 5 percent, Terro 5 percent, and Vonalee 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Hiland-Bowbac fine sandy loams soil is moderate and the available water capacity is moderate to high. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is severe.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.13 158-Hiland-Bowbac fine sandy loams, 6-15 percent slopes[1]

The Hiland-Bowbac fine sandy loams map unit consists of very deep well-drained soils that developed from alluvium on relict surfaces. It occurs on terraces, fans, fan remnants ridges, hills, and stabilized dunes at elevations between 4,100 and 5,300 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Hiland fine sandy loam and 30 percent Bowbac fine sandy loam. Within this map unit, the following additional components are found: Decolney 4 percent, Maysdorf 4 percent, Terro 4 percent, Vonalee 4 percent and Worf 4 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Hiland-Bowbac fine sandy loam soil is moderate, and the available water capacity is moderate to high. The effective rooting depth is between 20 and 60 inches. Surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is severe.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.14 170-Keeline-Tullock loamy sands, 6-30 percent slopes[1]

The Keeline-Tullock loamy sands map unit consists of very deep excessively drained soils that developed in alluvium derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, and benches at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44-49 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 40 percent Keeline loamy sands and 40 percent Tullock loamy sands. Within this map unit, the following additional components are found: Orpha 5 percent, Terro 5 percent, Taluce 5 percent, Vonalee 3 percent, Badland 2 percent, and Blowouts 1 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Keeline-Tullock loamy sands soil is rapid, and the available water capacity is low. The effective rooting depth is typically between 20 and 60 inches. Surface runoff is low, the hazard of water erosion is moderate, and the hazard of wind erosion is severe.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.15 171-Keeline-Tullock-Niobrara, dry complex, 3-30 percent slopes[1]

The Keeline-Tullock-Niobrara, dry complex map unit consists of very deep well- to excessively drained soils that developed in alluvium derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, and benches at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 17 inches. The average annual air temperature is approximately 44-49 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 30 percent Keeline soils, 25 percent Tullock soils, and 20 percent Niobrara soils. Within this map unit, the following additional components are found: Turnercrest 9 percent, Orpha 8 percent, Badland 7 percent and Blowouts 1 percent. Inclusions comprise approximately 25 percent of the map unit.

Permeability of the Keeline-Tullock-Niobrara, dry complex is rapid, and the available water capacity is low. The effective rooting depth is between 10 and 60 inches. Surface runoff is slow to moderate, the hazard of water erosion is severe, and the hazard of wind erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.16 180-Maysdorf-Pugsley sandy loams, 6-15 percent slopes[1]

The Maysdorf-Pugsley sandy loams map unit consists of very deep well-drained soils that developed from alluvium. It occurs on terraces, ridges, and hills at elevations between 4,100 and 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-50 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Maysdorf and 30 percent Pugsley sandy loams. Within this map unit, the following additional components are found: Bowbac 5 percent, Decolney 5 percent, Hiland 5 percent, and Vonalee 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Maysdorf-Pugsley sandy loams soil is moderate, and the available water capacity is high. The effective rooting depth is typically between 20 and 60 inches. Surface runoff is moderate, the hazard of water erosion is severe, and the hazard of wind erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.17 194-Pugsley-Decolney sandy loams, 6-15 percent slopes[1]

The Pugsley-Decolney sandy loams map unit consists of moderately deep well-drained soils that developed from weathered material derived from sedimentary rocks. This map unit occurs on hillslopes and stabilized dunes at elevations between 4,100 and 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 17 inches. The average annual air temperature is approximately 45-50 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Pugsley and 30 percent Decolney sandy loams. Within this map unit, the following additional components are found: Bowbac 7 percent, Hiland 7 percent, and Worf 6 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Pugsley-Decolney sandy loams soils is moderate, and the available water capacity is low. The effective rooting depth is typically between 20 and 60 inches. Surface runoff is moderate, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information and also occurs in Johnson County.

D7A.18 206-Samday-Shingle-Badland complex, 10-45 percent slopes[1]

The Samday-Shingle-Badland complex map unit consists of shallow well-drained soils that developed from residuum derived from clay shale. It occurs on upland ridgetops, shoulders, and backslopes at elevations between 4,100 and 5,800 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44-49 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 35 percent Samday soils, 30 percent Shingle soils, and 15 percent Badlands complex. Within this map unit, the following additional components are found: Hilight 4 percent, Kishona 4 percent, Theedle 4 percent, Wags 4 percent, and areas with 45-60 percent slope 4 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability of the Samday-Shingle-Badland complex soil is slow to moderate, and the available water capacity is very low. The effective rooting depth is between 10 and 20 inches. Surface runoff is severe, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.19 208-Savageton-Silhouette clay loams, 0-6 percent slopes[1]

The Savageton-Silhouette clay loams map unit consists of moderately deep well-drained soils that developed from alluvium derived from shale. It occurs on hills, ridges, fan remnants, and fan aprons at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 45 percent Savageton and 40 percent Silhouette clay loams. Within this map unit, the following additional components are found: Renohill 5 percent, Ulm 5 percent, and Heldt 5 percent. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Savageton-Silhouette clay loams soils is slow, and the available water capacity is moderate. The effective rooting depth is typically between 20 and 60 inches. Surface runoff is moderate, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information and also occurs in Johnson County.

D7A.20 211-Shingle-Worf loams, 3-30 percent slopes[1]

The Shingle-Worf loams map unit consists of shallow well-drained soils that developed from colluvium derived from shale and sandstone. It occurs on hillslopes and ridges at elevations between 4,100 and 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 45 percent Shingle and 35 percent Worf loams. Within this map unit, the following additional components are found: Cushman 5 percent, Samday 5 percent, Taluce 5 percent, and Theedle 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Shingle-Worf loams soil is moderate, and the available water capacity is very low. The effective rooting depth is typically between 10 and 20 inches. Surface runoff is very high, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.21 213-Terro-Taluce sandy loams, 6-30 percent slopes[1]

The Terro-Taluce sandy loams map unit consists of shallow to moderately deep well-drained soils that developed from residuum. It occurs on gently to steeply sloping hills, ridges, and plateaus at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 55 percent Terro loam and 25 percent Taluce sandy loam. Within this map unit, the following additional components are found: Keeline 5 percent, Orpha 5 percent, Turnercrest 4 percent, Vonalee 4 percent, and Badlands 2 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Terro-Taluce sandy loams soil is rapid, and the available water capacity is very low. The effective rooting depth is typically between 10 and 40 inches. Surface runoff is moderate to severe, the hazard of water erosion is severe, and the hazard of wind erosion is severe.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil with a potential stripping depth of 60 inches.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.22 216-Theedle-Kishona-Shingle loams, 3-30 percent slopes[1]

The Theedle-Kishona-Shingle loams map unit consists of moderately deep well-drained soils that developed from residuum derived from sandstone. It occurs on hills, ridges, and fan remnants at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 40 percent Theedle, 20 percent Kishona, and 20 percent Shingle loams. Within this map unit, the following additional components are found: Cambria 5 percent, Hilight 5 percent, Taluce 5 percent, and Turnercrest 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Theedle-Kishona-Shingle loams soil is moderate, and the available water capacity is low. The effective rooting depth is typically between 10 and 60 inches. Surface runoff is moderate to severe, the hazard of water erosion is also moderate to severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information and also occurs in Johnson County.

D7A.23 217-Theedle-Shingle loams, 3-30 percent slopes[1]

The Theedle-Shingle loams map unit consists of moderately deep well-drained soils that developed from alluvium derived from sandstone. It occurs on fan remnants, hills, and ridges at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 50 percent Theedle loam and 30 percent Shingle loam. Within this map unit, the following additional components are found: Keeline 5 percent, Kishona5 percent, Samday 5 percent, and Taluce 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Theedle-Shingle loams soil is moderate, and the available water capacity is low. The effective rooting depth is typically between 10 and 40 inches. Surface runoff is moderate to severe, the hazard of water erosion is severe, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.24 227-Ulm clay loam, 0-6 percent slopes[1]

The Ulm clay loam map unit consists of very deep well-drained soils that developed from alluvium derived from sedimentary rock. It occurs on alluvial fans, fan remnants, terraces, plateaus, ridges, and hills at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 46-51 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 85 percent Ulm clay loam. Within this map unit, the following additional components are found: Bidman 5 percent, Heldt 5 percent, and Wyarno 5 percent. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Ulm clay loam soil is slow, and the available water capacity is high. The effective rooting depth is typically 60 inches or more. Surface runoff is moderate, the hazard of water erosion is moderate, and the hazard of wind erosion is moderate.

Topsoil Suitability

This soil mapping unit is a fair source of topsoil.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.25 233-Ustic Torriorthents, gullied[1]

Ustic Torriorthents, gullied consists of solid strongly dissected soils that are entrenched by deep gullies. The soils are indistinct, varying in textures and thickness, and occur at elevations between 4,100 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average frost-free season is approximately 105-130 days.

This map unit is approximately 80 percent Ustic Torriorthents. Within this map unit, the following additional components are found: Haverdad 5 percent, Kishona 5 percent, Shingle 5 percent, and Theedle 5 percent. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Ustic Torriorthents, gullied soil ranges from moderately slow to moderately rapid, and the available water capacity is high. Surface runoff is severe, the hazard of water erosion is severe, and the hazard of wind erosion is severe.

Topsoil Suitability

There is no practical way any soil in this mapping unit can be removed or salvaged for reclamation purposes.

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[1] Map unit description based on 2002 South Campbell County NRCS information.

D7A.26 HH-Haverson-Glenberg association[1]

The Haverson-Glenberg association map unit consists of very deep well-drained soils that developed from mixed sources. It occurs on floodplains and low terraces at elevations between 4,500 and 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47-52 degrees F, and the average frost-free season is approximately 105-120 days.

This map unit is approximately 50 percent Haverson and 35 percent Glenberg soils. Within this map unit, the following additional components are found: Bankard 10 percent, Gravel bars 3 percent, and Unnamed 2 percent. Inclusions comprise approximately 15 percent of the map unit.

The available water capacity is moderate to high, surface runoff is slow, and the hazard of erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.27 HK-Haverson-Glenberg association, saline[1]

The Haverson-Glenberg association, saline map unit consists of very deep well-drained soils that developed from mixed sources. It occurs on floodplains and low terraces at elevations between 4,500 and 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47-52 degrees F, and the average frost-free season is approximately 105-120 days.

This map unit is approximately 50 percent Haverson and 25 percent Glenberg soils. Within this map unit, the following additional components are found: Unnamed 25 percent. Inclusions comprise approximately 25 percent of the map unit.

The available water capacity is moderate to high, surface runoff is slow, and the hazard of erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.28 LO-Limon-Cadoma association, 0-10 percent slopes[1]

The Limon-Cadoma association map unit consists of very deep well-drained soils that developed from clay and shale. It occurs on floodplains and alluvial fans at elevations between 4,500 and 5,200 ft AMSL.

The average annual precipitation ranges from 11 to 15 inches. The average annual air temperature is approximately 47-53 degrees F, and the average frost-free season is approximately 120-170 days.

This map unit is approximately 30 percent Limon and 30 percent Cadoma association. Within this map unit, the following additional components are found: Wyarno 20 percent, Orella 15 percent, and Petrie 5 percent. Inclusions comprise approximately 40 percent of the map unit.

The available water capacity is high, surface runoff is slow to moderate, and the hazard of erosion is moderate to severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.29 MP-Maysdorf-Pugsley association, 6-15 percent slopes[1]

The Maysdorf-Pugsley association map unit consists of very deep well-drained soils that developed from alluvium. It occurs on terraces, fan remnants, ridges, and hills at elevations between 4,500 and 5,500 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-50 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 35 percent Maysdorf and 30 percent Pugsley association. Within this map unit, the following additional components are found: Garret 20 percent, Cushman 10 percent, and Shingle 5 percent. Inclusions comprise approximately 35 percent of the map unit.

The available water capacity is moderate, surface runoff is moderate to rapid, and the hazard of erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.30 MR-Maysdorf-Schooner association, 6-15 percent slopes[1]

The Maysdorf-Schooner association map unit consists of very deep well-drained soils that developed from alluvium. It occurs on terraces, fan remnants, ridges, and hills at elevations between 4,500 and 5,500 ft AMSL.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-50 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 40 percent Maysdorf and 30 percent Schooner association. Within this map unit, the following additional components are found: Southfork 15 percent, Red embry 10 percent, and Pugsley 5 percent. Inclusions comprise approximately 30 percent of the map unit.

The available water capacity is moderate, surface runoff is moderate to rapid, and the hazard of erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.31 PXD-Pugsley-Southfork complex, hilly, 6-15 percent slopes[1]

The Pugsley-Southfork complex, hilly map unit consists of moderately deep well-drained soils that developed from weathered material derived from sedimentary rocks. It occurs on hillslopes at elevations of 4,100 to 5,000 ft AMSL.

The average annual precipitation ranges from 10 to 17 inches. The average annual air temperature is approximately 45-50 degrees F, and the average frost-free season is approximately 105-130 days.

This map unit is approximately 30 percent Pugsley and 30 percent Southfork complex. Within this map unit, the following additional components are found: Taluce 20 percent, Shingle 10 percent, Maysdorf 5 percent, and Rock Outcrop 5 percent. Inclusions comprise approximately 40 percent of the map unit.

The available water capacity is low, surface runoff is moderate to rapid, and the hazard of erosion is severe.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.32 STa-Stoneham-Absted complex, 0-3 percent slopes[1]

The Stoneham-Absted complex map unit consists of moderately deep well-drained soils that developed from alluvium derived from sandstone. It occurs on alluvial fans at elevations between 4,500 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 13 inches. The average annual air temperature is approximately 50 degrees F, and the average frost-free season is approximately 105-120 days.

This map unit is approximately 60 percent Stoneham and 20 percent Absted complex. Within this map unit, the following additional components are found: Bone 10 percent and Wyarno 10 percent. Inclusions comprise approximately 20 percent of the map unit.

The available water capacity is high, surface runoff is slow, and the hazard of erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

D7A.33 STe- Stoneham-Fort Collins association, 0-3 percent slopes[1]

The Stoneham-Fort Collins association map unit consists of moderately deep well-drained soils that developed from alluvium derived from sandstone. It occurs on alluvial fans at elevations between 4,500 and 5,200 ft AMSL.

The average annual precipitation ranges from 10 to 13 inches. The average annual air temperature is approximately 50 degrees F, and the average frost-free season is approximately 105-120 days.

This map unit is approximately 50 percent Stoneham and 30 percent Fort Collins soils. Within this map unit, the following additional components are found: Zigweid 10 percent, Ulm5 percent, and Wyarno 5 percent. Inclusions comprise approximately 20 percent of the map unit.

The available water capacity is high, surface runoff is slow, and the hazard of erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil.

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[1] Map unit description based on 1975 South Johnson County NRCS information.

ADDENDUM D7B:

SOIL SERIES DESCRIPTIONS

ADDENDUM D7B

SOIL SERIES DESCRIPTIONS

November 2007

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D7B.1 ARVADA SERIES

LOCATION ARVADA WY+CO KS MT NE SD
Established Series
MCS/JWW/CJH
12/2003

The Arvada series consists of very deep, well-drained soils formed in alluvium and colluvium derived from sodic shale. Arvada soils are on alluvial fans, fan remnants, fan terraces, and hillslopes. Slopes are 0 to 25 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustertic Natrargids

TYPICAL PEDON: Arvada fine sandy loam-rangeland. (Colors are for dry soil unless otherwise stated.)

E--0 to 4 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; moderate very thin platy structure parting to moderate very fine granular; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary (0 to 8 inches thick).

Btn--4 to 14 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium columnar structure parting to moderate medium angular blocky; extremely hard, firm, sticky, and very plastic; common medium roots; many prominent clay films on faces of peds and in root channels; very strongly alkaline (pH 9.2); ESP is 20 percent; clear smooth boundary (3 to 14 inches thick).

Btkn--14 to 20 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; extremely hard, firm, sticky, and very plastic; few faint clay films on faces of peds and in root channels; strongly effervescent, few fine segregations of calcium

carbonate in thin seams and streaks; strongly alkaline (pH 9.0); 20 percent exchangeable sodium; gradual smooth boundary (0 to 17 inches thick).

Bkny--20 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, friable, sticky, and plastic; violently effervescent, common medium soft masses of calcium carbonate and gypsum as crystals in thin seams and as filaments or threads; strongly alkaline (pH 8.8); 20 percent exchangeable sodium.

TYPE LOCATION: Sheridan County, Wyoming; 650 ft south and 200 ft west of the northeast corner of Sec. 29, T. 55 N., R. 78 W.; 44 degrees 43 minutes 7 seconds north latitude and 106 degrees 15 minutes 54 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to effervescent material ranges from 0 to 19 inches. Depth to layers with greater than 15 percent exchangeable sodium is 4 to 10 inches. The depth to the base of the Bt horizon is 15 inches or more. A thin A horizon occurs in some pedons. A light colored platy E horizon is generally present but is absent in some pedons. Gravel is typically less than 5 percent but ranges from 0 to 15 percent. The moisture control section is usually dry for 60 consecutive days during the 90 day period following the summer solstice. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 195 days. The soil has an aridic moisture regime that borders on ustic.

The E and A horizons have hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, 4 or 5 moist, and chroma of 2 to 4. Texture is fine sandy loam, loam, silt loam, clay loam, or very fine sandy loam. Reaction ranges from neutral through strongly alkaline. EC ranges from 0 to 4 mmhos/cm.

The Btn horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. Texture is clay, clay loam, silty clay, or silty clay loam and has 35 to 60 percent clay, 10 to 50 percent silt, and 5 to 45 percent sand. This horizon is strongly alkaline or very strongly alkaline (pH 8.8 to 10.0), has 15 to 34 percent exchangeable sodium, and an EC of 4 to 16 mmhos/cm. Some pedons when buffered by gypsum are moderately alkaline.

The Btkn horizon, when present, has a calcium carbonate equivalent of 3 to 12 percent and an exchangeable sodium percent of 10 to 30. A thin Bt horizon is present above the Btn in some pedons. Some pedons have a Btkny horizon.

The Bkny horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 or 6 dry, 4 or 5 moist. Textures are clay, clay loam, silty clay, or silty clay loam. Reaction ranges from strongly alkaline or very strongly alkaline (pH 8.6 to 10.0). This horizon contains 4 to 15 percent calcium carbonate equivalent. Some pedons when buffered by gypsum are moderately alkaline. Exchangeable sodium typically ranges from 10 to 30 percent but decreases with increasing depth. Electrical conductivity is 4 to 16 mmhos/cm. Some pedons have a C horizon.

Some pedons have a C horizon below 40 inches. It has properties similar to those of the Bkny horizon.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: The Arvada soils are on alluvial fans, fan remnants, terraces, and hillslopes. The soils formed in moderately fine-textured alluvium and colluvium derived from sedimentary rocks. Slopes range from 0 to 25 percent. Elevations range from 2,600 to 6,000 ft. The average annual precipitation is about 12 inches but ranges from 9 to 14 inches with about half the precipitation occurring during April, May, and early June. The mean annual air temperature is about 43 to 53 degrees F, and the mean summer temperature is 63 degrees F. The frost-free season is estimated to range from 100 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Absted, Bidman, Parmleed, Renohill, and Ulm soils. Absted soils have less than 15 percent sodium in the upper part of the argillic horizon. Bidman, Parmleed, Renohill, and Ulm soils lack natric horizons.

DRAINAGE AND PERMEABILITY: Well-drained; high or very high runoff; very slow permeability.

USE AND VEGETATION: Rangeland and wildlife habitat. Native vegetation is alkali sacaton, Gardner saltbush, western wheatgrass, and scattered greasewood.

DISTRIBUTION AND EXTENT: Eastern Wyoming, eastern Colorado, and parts of adjacent states. The series is extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Sheridan County, Wyoming; 1932.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Albic horizon - 0 to 4 inches (E)
Natric horizon - 4 to 20 inches (Btn, Btkn)

SIR - WY1130

LRR - G

National Cooperative Soil Survey
U.S.A.

D7B.2 BIDMAN SERIES

LOCATION BIDMAN WY+MT SD
Established Series
CJH-MS
11/2005

The Bidman series consists of very deep, well-drained soils that formed in alluvium weathered from shale bedrock. Bidman soils are on alluvial fans, fan remnants, terrace, ridges, and hills. Slopes are 0 to 25 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 47 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustic Paleargids

TYPICAL PEDON: Bidman loam-grassland. (Colors are for dry soil unless otherwise noted.)

E--0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak thin platy structure that parts to very fine granules; soft, very friable; uncoated sand grains; slightly acid (pH 6.4); abrupt smooth boundary (0 to 7 inches thick).

Bt--5 to 18 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium prismatic structure that parts to strong medium angular blocky; hard, very sticky, and very plastic; many prominent clay films on faces of peds, in channels, and pores; few streaks of bleached sand grains in the upper 2 inches; slightly alkaline (pH 7.4); clear wavy boundary (6 to 19 inches thick).

Btk--18 to 26 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak coarse prismatic structure that parts to moderate coarse angular and subangular blocks; extremely hard, very friable; sticky and plastic; few distinct clay films on faces of peds; strongly effervescent, calcium carbonate as soft masses and in thin seams and streaks; moderately alkaline (pH 8.4); gradual wavy boundary (0 to 23 inches thick).

Bk--26 to 60 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; massive; hard, very friable, sticky, and slightly plastic; violently effervescent, calcium carbonate as soft masses; strongly alkaline (pH 8.5).

TYPE LOCATION: Johnson County, Wyoming; 2,630 ft north and 20 ft west of the southeast corner of Sec. 19, T. 46 N., R. 80 W.; 43 degrees 56 minutes 26 seconds north latitude and 106 degrees 30 minutes and 41 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to calcareous material ranges from 8 to 26 inches. Depth to the base of the argillic horizon range from 15 to 36 inches. Organic carbon ranges from .6 to 1.5 percent in the surface horizons and decreases uniformly with increasing depth. Cation exchange capacity ranges from 60 to 90 milliequivalents per 100 grams of clay. Rock fragments are typically less than 2 percent but ranges from 0 to 15 percent. This soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is never moist in some or all parts for as long as 60 consecutive days during this same period. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or warmer for 175 to 195 days. The mean summer soil temperature at depth of 20 inches ranges from 59 to 65 degrees F.

The E horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry, 4 or 5 moist, and chroma of 2 to 4. It usually has platy structure but has granular structure in some pedons. It is loam, very fine sandy loam, or sandy loam. It is soft or slightly hard. Reaction is slightly acid to slightly alkaline. Some pedons have an A horizon.

The Bt horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is silty clay, silty clay loam, clay loam, or clay but has 35 to 50 percent clay, 15 to 45 percent silt, and 15 to 45 percent sand with more than 15 percent fine or coarser sand. This horizon typically has prismatic structure but has columnar or angular blocky structure in some

pedons. It has oriented clay films in some part. Reaction is neutral to moderately alkaline. EC is 0 to 8 mmhos/cm.

The Btk horizon has hue of 10YR or 2.5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 to 4. It is clay loam, silty clay loam, clay, or silty clay. It is slightly alkaline to strongly alkaline. It has a calcium carbonate equivalent of 5 to 12 percent. It has an EC of 0 to 2 mmhos/cm and 4 to 12 in the saline phase.

The Bk horizon ranges from 5Y, 2.5Y, or 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. It is clay loam, loam, sandy clay loam, or light clay. This horizon has 6 to 14 percent calcium carbonate equivalent. Reaction is moderately alkaline or strongly alkaline. EC is 0 to 12 mmhos.

Some pedons have a C horizon below 40 inches that have properties that are similar to the Bk horizon. A gravelly substratum phase is recognized.

COMPETING SERIES: These are the Big Horn, Briggsdale, Campo, Demar, Gibbler, and Parmleed series. Briggsdale, Gibbler, and Parmleed soils have bedrock at depths of less than 40 inches. Big Horn soils have a calcic horizon. Campo soils formed in aeolian parent sediments and have less than 15 percent fine or coarser sand in the Bt and C horizons. Demar soils are acid.

GEOGRAPHIC SETTING: The Bidman soils are on alluvial fans, fan remnants, terraces, ridges, and hills. Elevation is 2,600 to 6,000 ft. Slopes range from 0 to 25 percent. These soils formed in thick, calcareous alluvial sediments derived from sedimentary rock. At the type location, the mean annual temperature is 47 degrees F, and the mean summer temperature is 66 degrees F. The average annual precipitation is about 12 inches with about half the precipitation in April, May, and June. Precipitation ranges from 10 to 14 inches. The frost-free season is 100 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Briggsdale soils and the Redig and Wyarno soils. Redig soils are the main associated soils in Butte County, South Dakota. They have high gypsum content and are on more steeply sloping areas. Wyarno soils lack E horizons and do not have an abrupt textural boundary between the A and B horizons.

DRAINAGE AND PERMEABILITY: Well-drained; low to high runoff; slow permeability.

USE AND VEGETATION: Used principally as native pastureland but may be tilled to dryland or irrigated crops. Principal native vegetation is blue grama, western wheatgrass, and cactus.

DISTRIBUTION AND EXTENT: Northeastern and central Wyoming and western South Dakota. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Butte County, South Dakota; 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Albic horizon - 0 to 5 inches (E)
Argillic horizon - 5 to 26 inches (Bt, Btk)
An absolute increase in clay of greater than 15 percent within a vertical distance of 2.5 cm at the upper boundary of the Bt horizon.

SIR - WY1070

National Cooperative Soil Survey
U.S.A.

D7B.3 CUSHMAN SERIES

LOCATION CUSHMAN WY+MT SD
Established Series
CAP/GFK/CJH
05/2002

The Cushman series consists of well-drained soils that are moderately deep to bedrock. These soils formed in slopewash alluvium and residuum from interbedded shales and siltstone and fine-grained argillaceous sandstone. Cushman soils are on buttes, fan remnants, hills, piedmonts, ridges, and terraces. Slopes are 0 to 20 percent. The mean annual precipitation is about 13 inches, and the mean annual air temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

TYPICAL PEDON: Cushman very fine sandy loam on south facing slope of about 3 percent under native grass vegetation. (Colors are for dry soil unless otherwise stated.)

A--0 to 2 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, friable, slightly sticky, and slightly plastic; common very fine, fine, and few medium roots; slightly alkaline (pH 7.6); clear smooth boundary (2 to 6 inches thick).

Bt1--2 to 8 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky, and moderately plastic; common very fine, fine, and few medium roots; few faint clay films on faces of peds and lining pores; moderately alkaline (pH 7.9); clear smooth boundary.

Bt2--8 to 14 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure parting to strong medium angular blocky; hard, firm,

moderately sticky, and moderately plastic; few fine, medium, and coarse roots; common distinct clay films on faces of peds, lining pores, and root channels; slightly alkaline (pH 7.8); clear wavy boundary (combined Bt horizons 8 to 20 inches thick).

Btk--14 to 21 inches; pale brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) moist; moderate coarse prismatic structure parting to moderate fine and very fine subangular blocky; hard, firm, moderately sticky, and moderately plastic; few fine roots; few faint clay films on faces of peds; strongly effervescent; calcium carbonate on faces of peds and in pores as common distinct irregularly shaped filaments and masses; moderately alkaline (pH 8.2); clear smooth boundary (0 to 11 inches thick).

Bk--21 to 32 inches; very pale brown (10YR 8/2) loam, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; violently effervescent; calcium carbonate as common prominent irregularly shaped masses and many fine filaments; moderately alkaline (pH 8.4); clear smooth boundary (7 to 15 inches thick).

Cr--32 to 60 inches; soft, thickly stratified gray and brown calcareous shale; reaction of crushed fragments strongly alkaline; these shales extend to depths greater than 10 ft.

TYPE LOCATION: Sheridan County, Wyoming; SE1/4, NE1/4 of Sec. 2, T. 57 N., R. 84 W.; 44 degrees 56 minutes 53 seconds north latitude and 106 degrees 56 minutes 52 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to a paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 to 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least

60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. Reaction is neutral or slightly alkaline.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. Texture of the Bt is clay loam or loam with 20 to 35 percent clay and more than 15 percent but less than 35 percent fine sand or coarser. Reaction is neutral to moderately alkaline.

The Btk horizon has hue of 10YR or 2.5Y, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. Texture is loam or clay loam with 20 to 35 percent clay. Reaction is moderately alkaline or strongly alkaline. Calcium carbonate ranges from 3 to 12 percent.

The Bk horizon has hue of 10YR and 2.5Y, value of 6 to 8 dry, 4 to 6 moist, and chroma of 2 to 4. Texture is loam or clay loam with 20 to 30 percent total clay of which about 2 to 4 percent is carbonate clay. Reaction is typically moderately alkaline but may be strongly alkaline when sodic shales are present. Calcium carbonate equivalent is 5 to 15 percent, but some horizons may exceed 15 percent but are discontinuous or too thin to be considered as a calcic.

The Cr is weakly consolidated sedimentary rock. It is primarily calcareous shale; but siltstone or thinly interbedded fine-grained argillaceous sandstone is common. The rock is typically moderately alkaline or strongly alkaline when crushed, but slightly alkaline or neutral shales are not uncommon.

COMPETING SERIES: These are the Balon, Blancot, Bowbac, Buckle, Cambria, Cerrillos, Decolney, Doakum, Forkwood, Gapmesa, Hagerman, Hagerwest, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Pugsley, Quagwa, Redpen, Spangler, Spenlo, Sundance, and Teckla series. It is assumed the Gaddes and Yenlo are competing pending an

update of the classification. Balon, Blancot, Buckle, Cambria, Cerrillos, Decolney, Doakum, Forkwood, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Potts, Quagwa, Redpen, Spenlo, Sundance, Teckla, and Yenlo soils are deeper than 40 inches to any bedrock. Gaddes, Gapmesa, Hagerman, Hagerwest, and Progresso soils have lithic contacts between 20 and 40 inches. Bowbac and Pugsley soils have more than 35 percent fine sand or coarser in the particle-size control section. Pugsley soils are also noncalcareous throughout. Pokeman soils have redder hue and have a paralithic contact to gypsum or alabaster at 20 to 40 inches. Spangler soils are noncalcareous throughout and lack a Bk horizon.

GEOGRAPHIC SETTING: Cushman soils are on buttes, fan remnants, fan piedmonts, hills, and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine-textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin aeolian deposits overlie these soils in some areas. Elevations are 3,500 to 6,000 ft. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days, depending upon elevation, aspect, and air drainage.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Bowbac, Cambria, and Forkwood soils and the Absted, Hiland, Shingle, and Theedle soils. Absted soils have natric horizons. Hiland soils have more than 35 percent fine sand and coarser in the particle-size control section. Shingle soils are shallow and Theedle soils do not have an argillic horizon.

DRAINAGE AND PERMEABILITY: Well-drained; medium runoff; moderate permeability.

USE AND VEGETATION: Rangeland and wildlife habitat. Native vegetation is variable but western wheatgrass, needle-and-thread, big sagebrush, and blue grama are typical.

DISTRIBUTION AND EXTENT: Central and northern Wyoming and northeastern Colorado. The series is extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Big Horn County, Montana; 1941.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 2 inches (A)
Argillic horizon - 2 to 21 inches (Bt1,Bt2,Btk)
Paralithic contact - 32 inches (Cr)

SIR - WY1136

LRR - G

National Cooperative Soil Survey
U.S.A.

D7B.4 FORKWOOD SERIES

LOCATION FORKWOOD WY+MT
Established Series
CAP-GFK-CJH
10/2002

The Forkwood series consists of very deep, well-drained soils formed in alluvium. Forkwood soils are on terraces, alluvial fans, fan remnants, hills, ridges, and pediments. Slopes range from 0 to 15 percent. The mean annual precipitation is about 11 inches, and the mean annual air temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

TYPICAL PEDON: Forkwood loam - utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 5 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky, and slightly plastic; many fine and medium roots throughout; neutral; abrupt smooth boundary (1 to 6 inches thick).

Bt--5 to 12 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; slightly alkaline; clear smooth boundary (6 to 20 inches thick).

Btk--12 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong medium angular blocky structure; hard, firm, moderately sticky, and moderately plastic; few fine and medium roots throughout; few faint clay films on faces of peds; few masses of carbonates; slightly effervescent; slightly alkaline; clear smooth boundary (3 to 10 inches thick).

Bk--20 to 30 inches; light brownish gray (2.5Y 6/2) loam, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; few fine roots throughout; few fine threads and masses of carbonates throughout; strongly effervescent; moderately alkaline; gradual wavy boundary (9 to 45 inches thick).

BCk--30 to 60 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky, and slightly plastic; few fine roots throughout; few masses of carbonates throughout; strongly effervescent; moderately alkaline (0 to 40 inches thick).

TYPE LOCATION: Niobrara County, Wyoming; about 1,000 ft south and 1,100 ft west of the northeast corner of Sec. 2, T. 36 N., R. 65 W.

RANGE IN CHARACTERISTICS: Depth to the base of the argillic horizon is 10 to 33 inches, and depth to continuous horizons of carbonate accumulation is 10 to 33 inches. Rock fragments range from 0 to 15 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature ranges from 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 4 mmhos/cm throughout the profile. Bedrock is deeper than 60 inches.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. A vesicular crust occurs on some pedons. Texture is very fine sandy loam, loam, clay loam, or fine sandy loam. Reaction is neutral through moderately alkaline.

The Bt horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 7 dry and 3 to 5 moist, and chroma of 2 to 4. Texture is loam or clay loam with 18 to 35 percent clay and more than 15 but less than 35 percent fine sand or coarser. Reaction is neutral through moderately alkaline.

The Btk horizon has hue of 2.5Y or 10YR, value of 4 to 7 dry and 3 to 5 moist, and chroma of 2 to 4. Texture is loam or clay loam. It is slightly alkaline or moderately alkaline. It has 3 to 12 percent calcium carbonate equivalent.

The Bk horizon has hue of 5Y, 2.5Y, or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture is loam, fine sandy loam, very fine sandy loam, or clay loam. This horizon has 1 to 14 percent authigenic calcium carbonate accumulation. It is moderately alkaline or strongly alkaline.

The C horizon, when present, has hue of 5Y to 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. Carbonates range from 1 to 8 percent and are mostly allogenic. ESP ranges from 4 to 12. Reaction is moderately or strongly alkaline.

COMPETING SERIES: These are the Balon, Blancot, Bowbac, Buckle, Cambria, Cerrillos, Cushman, Decolney, Doakum, Gaddes, Gapmesa, Hagerman, Hagerwest, Hiland, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Pugsley, Quagwa, Redpen, Spangler, Spenlo, Sundance, Teckla, and Yenlo series (Gaddes and Yenlo are presumed to be competing pending an update of the classification). Balon soils are noncalcareous. Blancot soils have discontinuous horizons of carbonate accumulation. Bowbac, Cerrillos, Cushman, Gaddes, Gapmesa, Hagerman, Pokeman, Pugsley, Spangler, and Threetop soils have bedrock at a depth of 20 to 40 inches. Buckle and Palacid soils have sola more than 40 inches thick. Cambria soils have Bt horizons that have a base at less than 10 inches from the soil surface. Cerrillos, Potts, and Spenlo soils have hue of 7.5YR or redder throughout the profile. Decolney, Hiland, Olney, and Penistaja soils have more than 35 percent fine sand and coarser in the particle-size control section. Doakum soils have average annual soil temperature of 52 to 56 degrees F. Hagerwest, Mentmore, and Quagwa soils are driest during May and June. Los Alamos soils have pumice and ash at depths of 20 to 50 inches. Oelop, Palacid, and Yenlo soils are moist in some or all parts of the moisture control section for 60 consecutive days following July 15 and are moist in some parts for at least 90 cumulative days when the soil temperature at a depth of 20 inches is 41 degrees F. Redpen soils have hue of 2.5YR. Sundance and Teckla soils have lithologic discontinuities.

GEOGRAPHIC SETTING: Forkwood soils are on terraces, alluvial fans, fan remnants, hills, ridges, and pediments. Slopes are 0 to 15 percent. The soils formed in slopewash alluvium derived from interbedded shales and argillaceous sandstone. Elevations are 3,500 to 6,000 ft. The average annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature ranges from 43 to 51 degrees F. The estimated frost-free season is about 105 to 130 days, depending upon elevation, aspect, and air drainage.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Cushman and Hiland soils and the Absted, Arvada, Haverdad, Kishona, and Shingle soils. Cushman and Shingle soils are on shoulder slopes and summits of hills and ridges. Shingle soils have bedrock at a depth of 4 to 20 inches. Absted, Arvada, Hiland, and Kishona soils occur on similar landscape positions as the Forkwood soils. Absted and Arvada soils have natric horizons. Haverdad and Kishona soils lack an argillic horizon. Haverdad soils occur on floodplains and terraces.

DRAINAGE AND PERMEABILITY: Well-drained; low to medium runoff; moderate permeability.

USE AND VEGETATION: These soils are used principally for livestock grazing and wildlife habitat. Native vegetation is big sagebrush, bluebunch wheatgrass, Sandberg bluegrass, and needle-and-thread.

DISTRIBUTION AND EXTENT: Central and northern basin areas of Wyoming and northern Colorado.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Washakie County, Wyoming; 1980.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 5 inches (A horizon)

Argillic horizon - 5 to 20 inches (Bt and Btk horizons)

SIR - WY1139

LRR - G

National Cooperative Soil Survey

U.S.A.

D7B.5 HAVERDAD SERIES

LOCATION HAVERDAD WY+MT UT
Established Series
Rev. JEI/MCS/SSP
06/2002

The Haverdad series consists of very deep, well-drained soils formed in stratified alluvium on floodplains and low terraces. Permeability is moderate. Slopes range from 0 to 6 percent. The mean annual precipitation is about 11 inches, and the mean annual temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

TYPICAL PEDON: Haverdad loam - utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular structure parting to weak fine granular; slightly hard, friable, slightly sticky, and slightly plastic; many fine roots throughout; carbonates are disseminated throughout; slightly effervescent; moderately alkaline (pH 8.0); gradual smooth boundary (2 to 8 inches thick).

C1--4 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; common fine roots throughout; carbonates are disseminated throughout; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C2--14 to 30 inches; pale brown (10YR 6/3) loam, stratified with fine sandy loam, sand loam, clay loam, and silt loam, brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; few fine and very fine roots

throughout; carbonates are disseminated throughout; slightly effervescent; strongly alkaline (pH 8.6); gradual smooth boundary.

C3--30 to 60 inches; pale brown (10YR 6/3) clay loam, stratified with fine sandy loam, loam, silt loam, and silty clay loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; few fine and very fine roots throughout; carbonates are disseminated throughout; slightly effervescent; strongly alkaline (pH 8.6); gradual smooth boundary.

TYPE LOCATION: Niobrara County, Wyoming; about 2,600 ft north and 750 ft east of the southwest corner of Sec. 12, T 38 N, R 65 W.; latitude 43 degrees 17 minutes 2 seconds north and longitude 104 degrees 36 minutes 54 seconds west.

RANGE IN CHARACTERISTICS:

Soil moisture: The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F or more. This soil is moist for 60 consecutive days when the soil temperature at 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period.

Mean annual soil temperature: 48 to 53 degrees F and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 195 days.

Organic carbon content: .5 to 1.0 percent and decreases irregularly with depth

Rock fragments: 0 to 15 percent gravel

EC (mmhos/cm): 0 to 8 mmhos throughout but where irrigated some soils may range up to 16 mmhos

Calcium sulfate occurs in some pedons.

The soil is typically calcareous to the surface, but some pedons are leached as deep as 20 inches.

A horizon:

Hue: 10YR or 2.5Y

Value: 4 through 6 dry, 3 through 5 moist

Chroma: 2 through 4 dry or moist

Texture: loam, clay loam, silt loam, silty clay loam, very fine sandy loam, fine sandy loam, sandy loam

Reaction: slightly alkaline through strongly alkaline

Some pedons have an AC horizon.

C horizon:

Hue: 10YR or 2.5Y

Value: 5 through 7 dry, 4 to 6 moist

Chroma: 2 through 4 dry or moist

Texture: variable but when averaged is loam or light clay loam with 18 to 35 percent clay

Calcium carbonate equivalent: 1 to 15 percent, which changes erratically between strata

Reaction: slightly alkaline through strongly alkaline

COMPETING SERIES: These are the Hamburn, Manikan, San Mateo, and Suwanee series.

Hamburn: have pedogenic accumulations of salt and SARs greater than 13

Manikan and Suwanee: have hue of 7.5YR or redder

San Mateo: have soil moisture control sections that are drier during April, May, and June

GEOGRAPHIC SETTING:

Parent material: alluvium from mixed sources

Landform: floodplains and low terraces

Elevations: 3,500 to 6,500 ft

Slopes: 0 to 6 percent

Mean annual precipitation: about 11 inches, ranging 10 to 17, with over half of annual precipitation falling in April, May, and June

Mean annual temperature: about 45 degrees F and ranges from 43 to 52 degrees F

Frost-free period: 105 to 130 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Arvada, Forkwood, Kishona, and Shingle soils. Arvada soils have a natric horizon. Forkwood soils have an argillic horizon. Kishona soils lack stratification. Shingle soils have bedrock at a depth of 4 to 20 inches.

DRAINAGE AND PERMEABILITY: Well drained; slow runoff; moderate permeability. Flooding for brief periods occurs during spring runoff and after thunder showers.

USE AND VEGETATION: These soils are used principally for grazing. Principal native vegetation is big sagebrush, western wheatgrass, greasewood, and annual grasses and forbs.

DISTRIBUTION AND EXTENT: Big Horn Basin, central, eastern Wyoming, Colorado, and Utah.

MLRA OFFICE RESPONSIBLE: Lakewood, Colorado

SERIES ESTABLISHED: Washakie County, Wyoming; 1980.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 6 inches (A)

The type location for this series was moved from Washakie County, Wyoming, to its current location in Niobrara County, Wyoming, to better reflect the moisture regime concept, June 2002.

National Cooperative Soil Survey

U.S.A.

D7B.6 HAVERSON SERIES

LOCATION HAVERSON CO+MT NE NM SD UT WY
Established Series
AJC/JEB/CJH
12/2002

The Haverson series consists of very deep, well-drained soils that formed in alluvium from mixed sources. Haverson soils are on floodplains and low terraces and have slopes of 0 to 9 percent. The mean annual precipitation is about 15 inches, and the mean annual air temperature is about 49 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Aridic Ustifluvents

TYPICAL PEDON: Haverson loam - grassland. (Colors are for dry soil unless otherwise noted.)

A1--0 to 3 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; strong fine granular structure; slightly hard, very friable; violently effervescent; slightly alkaline (pH 7.8); clear smooth boundary (2 to 6 inches thick).

A2--3 to 6 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; hard, friable; strongly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary (2 to 6 inches thick).

A3--6 to 12 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; very hard, friable; strongly effervescent; slightly alkaline (pH 7.8); clear smooth boundary (4 to 8 inches thick).

C1--12 to 32 inches; pale brown (10YR 6/3) very fine sandy loam that has thin strata of loam, brown (10YR 4/3) moist; massive; hard, friable; strongly effervescent; slightly alkaline (pH 7.8); gradual smooth boundary (16 to 24 inches thick).

C2--32 to 60 inches; pale brown (10YR 6/3) loam that has thin lenses of sandy loam and very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; few fine irregularly shaped masses and seams of lime; strongly effervescent; moderately alkaline (pH 8.4).

TYPE LOCATION: Weld County, Colorado; approximately 1,320 ft south and 1,320 ft east of the northwest corner of Sec. 36, T. 10 N., R 64 W.

RANGE IN CHARACTERISTICS: Mean annual soil temperature ranges from 47 to 55 degrees F and mean summer soil temperature ranges from 59 to 78 degrees F. Organic carbon ranges from 0.5 to 2.0 percent in the surface horizon but decreases irregularly with depth. The particle-size control section is stratified with strata ranging from sandy loam to clay loam, but averaging approximately loam. On a weighted average basis, clay ranges from 18 to 35 percent, silt from 10 to 50 percent, and sand from 20 to 60 percent with more than 15 percent but less than 35 percent being fine or coarser sand. Rock fragments are generally less than 5 percent and range from 0 to 20 percent. Some visible calcium carbonate may occur at any depth in these soils, but it is not concentrated into any consistent horizon of accumulation. This soil is not dry in all parts of the moisture control section for more than one-half the time the soil temperature is above 41 degrees F (195 to 210 days) and is not dry for 45 consecutive days following July 15.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 or 3. When the value of the surface horizon is as dark as 5 dry and 3 moist, the horizon is thin enough so that if mixed to 7 inches it is too light colored or contains too little organic carbon to qualify as a mollic epipedon or are finely stratified. The A horizon usually has granular primary structure but it has subangular blocky structure in some pedons. It is soft or slightly hard. It is neutral through moderately alkaline.

The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 or 3. It is slightly alkaline to very strongly alkaline. It has from less-than-one to about 15 percent calcium carbonate equivalent, which differs erratically from stratum to stratum.

COMPETING SERIES: These are the Aparejo, Hickman, Hysham, Ramper, and Rockypoint series (it is assumed Hickman soils are competing pending an update of the classification). Aparejo, Hickman, and Ramper soils are driest during May and June in the moisture control section. In addition, Aparejo soils have hues of 5YR and redder. Hysham soils have very strongly alkaline surface horizons and typically have Bt horizons with columnar structure. Rockypoint soils are dry from July through September.

GEOGRAPHIC SETTING: The Haverson soils are on floodplains and low terraces of major rivers. Slope is 0 to 9 percent. The soils formed in highly stratified, calcareous, recent alluvium derived from mixed sources. At the type location the average annual precipitation is 14 to 18 inches with peak periods of precipitation occurring during the early spring and summer. The mean annual air temperature ranges from 47 to 52 degrees F and the mean summer temperature is 77 degrees F. The frost-free season is 125 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bankard and Glenberg soils. Bankard and Glenberg soils have less than 18 percent clay in the series control section.

DRAINAGE AND PERMEABILITY: Well drained; runoff is negligible to medium depending on slope; moderate permeability.

USE AND VEGETATION: These soils are used as native pastureland, dry farm land, or irrigated cropland. Native vegetation is mixed grasses, cottonwoods, and brush.

DISTRIBUTION AND EXTENT: Eastern Colorado and Wyoming, northeastern New Mexico, and adjacent states. This soil is of large extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Prowers County, Colorado; 1965.

REMARKS: Classification was changed from Ustic Torrifluvents to Aridic Ustifluvents and the type location moved from Prowers County to Weld County, Colorado, in 3/94.

National Cooperative Soil Survey
U.S.A.

D7B.7 HILAND SERIES

LOCATION HILAND WY+MT
Established Series
CAP-GFK-CJH
09/2005

The Hiland series consists of very deep, well-drained soils formed in alluvium or aeolian deposits on relict surfaces consisting of terraces, fans, fan remnants, pediments, ridges, hills, and stabilized dunes. Permeability is moderate. Slopes range from 0 to 20 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

TYPICAL PEDON: Hiland fine sandy loam - on northeast facing slope of 3 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 2 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak medium granular structure parting to weak fine granular; slightly hard, friable, nonsticky, and nonplastic; many very fine and common fine roots; neutral (pH 7.2); abrupt smooth boundary (2 to 5 inches thick).

E--2 to 6 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak thin platy structure parting to moderate fine and medium granular; slightly hard, friable, nonsticky, and nonplastic; many very fine and common fine roots; neutral (pH 7.2); abrupt smooth boundary (0 to 5 inches thick).

Bt1--6 to 12 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; strong medium prismatic structure parting to strong fine and medium angular blocky; hard, friable, moderately sticky, and moderately plastic; many very fine roots in a mat at the top of the horizon

and common very fine roots between peds; many fine pores; many prominent continuous dark brown (7.5YR 3/3) clay films on faces of peds; slightly alkaline (pH 7.4); clear wavy boundary.

Bt2--12 to 17 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; common fine and medium distinct yellowish brown (10YR 5/6) and common fine light brownish gray (10YR 6/2) relic redoximorphic features; strong medium prismatic structure parting to moderate medium subangular blocky; hard, firm, moderately sticky, and moderately plastic; common very fine roots between peds; many fine pores; common prominent continuous dark brown (10YR 3/3) clay films on faces of peds and occur as fillings in root channels and pipes; slightly alkaline (pH 7.4); gradual wavy boundary.

Bt3--17 to 31 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; common fine and medium distinct yellowish brown (10YR 5/6) common fine light brownish gray (10YR 6/2) relic redoximorphic features; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, moderately sticky, and moderately plastic; common very fine roots between peds; many fine pores; few distinct continuous brown (10YR 4/3) clay films on faces of peds and occur as fillings in root channels and pipes; slightly alkaline (pH 7.4); gradual wavy boundary (combined Bt horizons 13 to 32 inches thick).

Bk--31 to 60 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky, and nonplastic; common very fine roots; many fine pores; few fine and medium rounded light gray (10YR 7/2) masses of carbonate throughout; strongly effervescent; moderately alkaline (pH 8.4); gradual smooth boundary.

TYPE LOCATION: Converse County, Wyoming; about 3,200 ft south and 500 ft west of the northeast corner of Sec. 3, T. 33 N., R. 69 W.; latitude 42 degrees 51 minutes 33 seconds north and longitude 105 degrees 7 minutes 6 seconds west.

RANGE IN CHARACTERISTICS: Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches.

Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about Apri 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

The A horizon has hue of 10YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. It is sandy loam, fine sandy loam, very fine sandy loam, sandy clay loam, or loamy sand. Vesicular crust occurs on some pedons. This horizon is neutral to moderately alkaline.

The E horizon has hue of 10YR, value of 4 to 6 and 3 to 5 moist, and chroma of 2 to 4. It is fine sandy loam, very fine sandy loam, sandy loam, sandy clay loam, or loamy sand. It is neutral or slightly alkaline.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. It has a weighted clay content of 20 to 35 percent and is sandy clay loam; however, parts of this horizon may be sandy loam. This horizon is typically noncalcareous. Reaction is neutral to moderately alkaline.

If a Btk horizon is present, it has the same ranges as defined for the Bt except that it is replugged with carbonate and reaction ranges from moderately to strongly alkaline.

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 7 moist, and chroma of 2 to 4. It is sandy loam, loamy sand, fine sandy loam, or sandy clay loam; or, when other textures occur, the horizon average must be sandy loam, loamy sand, or fine sandy loam. It is not a calcic horizon. It does not have 5 percent more calcium carbonate equivalent than the

underlying horizon or has less than 5 percent secondary carbonates. It is moderately or strongly alkaline. Exchangeable sodium is less than 15 percent even though field tests indicate strongly alkaline reactions.

Some pedons have a 2Bk, 2C, or C horizon. The 2C and 2Bk horizons may contain more rock fragments. Contrasting textures of sand may occur below 40 inches. It is calcareous but typically has less than 5 percent calcium carbonate equivalent.

COMPETING SERIES: These are the Balon, Blancot, Bowbac, Buckle, Cambria, Cerrillos, Cushman, Decolney, Doakum, Forkwood, Fort, Gaddes, Gapbutte, Gapmesa, Hagerman, Hagerwest, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Pugsley, Quagwa, Redpen, Spangler, Spenlo, Sundance, Teckla, and Yenlo soils (it is assumed Gaddes and Yenlo are competing pending an update of the classification). Balon soils are noncalcareous. Blancot soils have discontinuous horizons of carbonate accumulation. Bowbac, Cerrillos, Cushman, Gaddes, Gapmesa, Hagerman, Pokeman, Pugsley, and Spangler soils are moderately deep. Buckle, Hagerwest, Mentmore, Palacid, and Quagwa soils are driest during May and June. Cambria soils have Bt horizons that have a base at depths of less than 10 inches from the soil surface. Cerrillos, Potts, and Spenlo soils have hues of 7.5YR or redder throughout the profile. Decolney soils have carbonates at deeper than 40 inches. Doakum soils have annual average soil temperatures of 52 to 56 degrees F. Forkwood soils have less than 35 percent fine sand and coarser in the particle-size control section. Los Alamos soils have pumice and ash at depths of 20 to 50 inches. Oelop, Palacid, Penistaja, and Yenlo soils are moist in some or all parts of the moisture control section for 60 consecutive days following July 15 and are moist in some parts for at least 90 cumulative days when the soil temperature at 20 inches is 41 degrees F. Olney soils are moist in some part of the soil moisture control section for at least 90 cumulative days when the soil temperature at 20 inches is 41 degrees F or more. Redpen soils have hue of 2.5YR. Sundance and Teckla soils have lithologic discontinuities.

GEOGRAPHIC SETTING: Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills, and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and aeolian material derived predominantly from

sandstone. Elevations are 3,500 to 6,300 ft. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Bowbac, Decolney, and Forkwood soils and the Absted, Arvada, Haverdad, Kishona, Keyner, Shingle, and Taluce soils. Arvada, Absted, and Keyner soils have a natric horizon. Decolney soils have carbonates at depths of more than 40 inches. Haverdad and Kishona soils lack an argillic horizon. Shingle and Taluce soils are shallow.

DRAINAGE AND PERMEABILITY: Well drained; low or medium runoff; moderate permeability.

USE AND VEGETATION: These soils are used principally for grazing. Principal native vegetation is big sagebrush, silver sagebrush, rhizomatous wheatgrass, blue grama, and needle-and-thread.

DISTRIBUTION AND EXTENT: Big Horn Basin and eastern Wyoming.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Converse County, Wyoming; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 6 inches (A and E horizons)
Argillic horizon - 6 to 31 inches (Bt1, Bt2, and Bt3 horizons)
SIR - WY1343
LRR - G

National Cooperative Soil Survey

U.S.A.

D7B.8 KEELINE SERIES

LOCATION KEELINE WY
Established Series
Rev. RLR/JAL
11/2005

The Keeline series consists of very deep, well or somewhat excessively drained soils formed in alluvium or aeolian deposits derived from sandstone. Keeline soils are on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants. Slopes range from 0 to 40 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

TYPICAL PEDON: Keeline sandy loam on east facing shoulder slope of 4 percent utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 3 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky, and nonplastic; slightly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.6); abrupt smooth boundary (2 to 8 inches thick).

Bw--3 to 8 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; strongly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.8); clear smooth boundary (0 to 7 inches thick).

C1--8 to 17 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky, and nonplastic; strongly effervescent; calcium

carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary (8 to 50 inches thick).

C2--17 to 30 inches; very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky, and nonplastic; strongly effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary (0 to 25 inches thick).

C3--30 to 60 inches; very pale brown (10YR 7/3) sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky, and nonplastic; strongly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2).

TYPE LOCATION: Converse County, Wyoming; 2,100 ft north and 400 ft west of the SE corner of Sec. 29, T. 40 N., R. 75 W.; 43 degrees 24 minutes 27 seconds north latitude and 105 degrees 52 minutes 46 seconds west longitude.

RANGE IN CHARACTERISTICS: Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6 inches. The control section averages fine sandy loam or sandy loam with 5 to 18 percent clay. Rock fragments range from 0 to 15 percent. Some thin strata of coarser material may occur. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 4 mmhos throughout the profile. Bedrock is deeper than 60 inches.

The A horizon has hue of 7.5YR through 2.5Y, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4. It is sandy loam and less commonly loamy sand, fine sandy loam, or loamy fine sand. Reaction is neutral to moderately alkaline.

The Bw horizon, when present, has the same properties of the A except for structure, which is usually weak subangular blocky.

Some pedons have an AC horizon.

The C horizon has hue of 7.5YR through 5Y, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture averages sandy loam or fine sandy loam. Some pedons have subhorizons of very fine sandy loam or loamy fine sand. Reaction is moderately or strongly alkaline and some pedons have weak, discontinuous accumulations of calcium carbonate.

COMPETING SERIES: These are the Cliff, Councelor, Henrieville, Nelman, Nelson, Oterodry, Pedrick, Shedado, Turnercrest, Uendal, Yarts, and Zia series. Nelman, Shedado, and Uendal soils have lithic contacts at depths of 20 to 40 inches. Nelson and Turnercrest soils have paralithic contacts at depths of 20 to 40 inches. Cliff, Councelor, Henrieville, Otero, Pedrick, and Zia soils are not dry for 60 consecutive days in the moisture control section from July 15 to October 25. Yarts soils have 2.5YR through 7.5YR hues throughout.

GEOGRAPHIC SETTING: Keeline soils are on terraces, benches, alluvial fans, fan remnants, ridgetop, and hillslope positions. Slopes are 0 to 40 percent. These soils formed in moderately coarse alluvium or aeolian deposits derived from calcareous sandstone. Elevations are 3,500 to 6,200 ft. The average annual precipitation is 12 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 15 inches. The mean annual temperature is about 46 degrees F but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dwyer, Orpha, Tassel, Terro, Tullock, Turnercrest, and Vonalee soils. Dwyer, Orpha, and Tullock soils have sandy control sections. Tassel soils have paralithic bedrock at 10 to 20 inches. Terro and Vonalee soils have argillic horizons. Turnercrest soils have paralithic bedrock at 20 to 40 inches.

DRAINAGE AND PERMEABILITY: Well or somewhat excessively drained; slow runoff; moderately rapid permeability.

USE AND VEGETATION: These soils are dominantly used for grazing. Potential native vegetation is needle-and-thread, prairie sandreed, Indian ricegrass, and little bluestem.

DISTRIBUTION AND EXTENT: Powder River Basin and adjacent areas of eastern Wyoming. Series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bozeman, Montana

SERIES ESTABLISHED: Converse County, Wyoming, North Part; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - 0 to 3 inches (A)
2. Ustic subgroup - Aridic moisture regime bordering on Ustic.

SIR - WY1293

LRR - G

National Cooperative Soil Survey
U.S.A.

D7B.9 LIMON SERIES

LOCATION LIMON CO+KS UT WY

Established Series

GB/LLC

04/2003

The Limon series consists of very deep, well-drained, slowly permeable soils that formed in relatively uniform alluvial deposits derived principally from clay and shale. The Limon soils are on floodplains or alluvial fans and have slopes of 0 to 12 percent. The mean annual precipitation is 13 inches, and the mean annual temperature is 48 degrees F.

TAXONOMIC CLASS: Fine, smectitic, calcareous, mesic Ustertic Torriorthents

TYPICAL PEDON: Limon silty clay loam - grassland. (Colors are for dry soil unless otherwise noted.)

A--0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; weak platy in the upper 1/4 inch; soft, very friable; calcareous; moderately alkaline (pH 8.2); clear smooth boundary (2 to 6 inches thick).

AC--4 to 20 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse angular blocky structure; extremely hard friable, very plastic; calcareous; moderately alkaline (pH 8.4); gradual wavy boundary (10 to 18 inches thick).

Bk--20 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay, olive brown (2.5Y 4/3) moist; massive; extremely hard, firm, very plastic; few visible secondary calcium carbonate concretions; calcareous; moderately alkaline (pH 8.4).

TYPE LOCATION: Bent County, Colorado; approximately 0.45 mi north and 0.15 mi east of the southwest corner of sec. 7, T. 21 S., R. 52 W.

RANGE IN CHARACTERISTICS: Mean annual soil temperature ranges from 47 to 58 degrees F.

Mean summer soil temperature ranges from 59 to 78 degrees F.

These soils are moist in some part of the soil moisture control section for 60 consecutive days when the soil temperature at 20 inches is 41 degrees F or greater.

Aridic moisture regime bordering on ustic.

Organic carbon content: The A horizon ranges from 0.6 to 1.5 percent and decreases uniformly with increasing depth.

Electrical conductivity: less than 1 to 4 millimhos, but may range to 10 millimhos/cm in some pedons

Exchangeable sodium percentage: 1 to 14 percent throughout the particle size control section, but both differs widely between individual horizons

Cation exchange capacity: 60 to 90 millequivalents per 100 grams of clay

The particle size control section:
Texture: silty clay, clay, or heavy silty clay loam
Clay content: 35 to 60 percent
Silt content: 10 to 60 percent
Sand content: 5 to 40 percent with less than 35 percent fine sand or coarser
Rock fragments: 0 to 10 percent but are typically less than 2 percent

A horizon:
Hue: 5Y to 10YR
Value: 5 to 7 dry, 3 to 6 moist

Chroma: 2 or 3

Reaction: slightly alkaline to strongly alkaline (A and AC horizons)

C horizon:

Hue: 10YR to 5Y

Texture: silty clay, clay, or heavy silty clay loam

Clay content: 35 to 60 percent

Calcium carbonate equivalent: less than 1 to about 8 percent with visible calcium carbonate occurring inconsistently as to amount and depth

Gypsum content: 0 to 3 percent

Reaction: slightly alkaline to strongly alkaline

COMPETING SERIES: These are the Bahl (WY), Baldfield (UT), Bodry, Petrie (WY), and Shower (UT) series.

Bahl soils are dry in some part of the soil moisture control section for as long as 60 consecutive days when the soil temperature at 20 inches is 41 degrees F, which occurs on about April 24.

Baldfield soils are dry in the soil moisture control section less than one-half of the time when the soil temperature at 20 inches is greater than 41 degrees F.

Bodry soils have a paralithic contact at depths of 20 to 40 inches.

Petrie soils have 15 to 40 percent ESP throughout the particle size control section.

Shower soils have endosaturation at depths of 18 to 24 inches.

GEOGRAPHIC SETTING:

Parent material: alluvial deposits derived primarily from clay shales

Landform: floodplains and alluvial fans

Slopes: range from 0 to 12 percent

Average annual precipitation: 11 to 15 inches, with peak periods of precipitation during the spring and summer

Average annual temperature is 47 to 53 degrees F, and the average summer temperature is 65 to 74 degrees F.

Frost-free season: 120 to 170 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Gaynor and Samsil series. Gaynor soils have a paralithic contact at depths of 20 to 40 inches. Samsil soils have a paralithic contact at a depth of less than 20 inches.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; slow permeability.

USE AND VEGETATION: These soils are used primarily as native pastureland. They are irrigated in some small areas. Native vegetation is short grasses, western wheatgrass, sage, and cactus.

DISTRIBUTION AND EXTENT: Eastern Colorado, southeastern Wyoming, and probably northeastern New Mexico. The series is of moderate extent. LRR G, MLRA's 67 and 69.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Johnson County (Southern Johnson Area), Wyoming; 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon:

Ochric epipedon: 0 to 4 inches (A horizon)

Aridic moisture regime bordering ustic.

The assignment of the cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

Taxonomic Version: Second Edition, 1999

National Cooperative Soil Survey

U.S.A.

D7B.10 MAYSDORF SERIES

LOCATION MAYSDORF WY
Established Series
MCS/JWW/CJH
03/2003

The Maysdorf series consists of very deep, well-drained, moderately permeable soils formed in alluvium or aeolian deposits on terraces, fan remnants, alluvial fans, ridges, and hills. Slopes are 0 to 15 percent. Elevation is 3,800 to 5,500 ft. The mean annual air temperature is about 46 degrees F. The mean annual precipitation is about 12 inches. The frost-free period is 105 to 130 days.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Calciargids

TYPICAL PEDON: Maysdorf fine sandy loam, grassland. (Colors are for dry soil unless otherwise stated.)

A--0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky, and nonplastic; many very fine and fine roots throughout; neutral; clear smooth boundary (2 to 5 inches thick).

BA--3 to 7 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; many very fine and fine roots throughout; few distinct discontinuous dark brown (7.5YR 3/4) clay bridging between sand grains; slightly alkaline; abrupt smooth boundary (0 to 8 inches thick).

Bt1--7 to 19 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; strong medium prismatic structure; hard, firm, moderately sticky, and moderately plastic;

many very fine and fine roots throughout; few distinct discontinuous dark reddish brown (5YR 3/4) clay films on faces of peds; slightly alkaline; abrupt smooth boundary.

Bt2--19 to 33 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium angular blocky; hard, firm, moderately sticky, and moderately plastic; many very fine and fine roots throughout; few distinct discontinuous dark brown (7.5YR 3/3) clay films on faces of peds; slightly alkaline; clear smooth boundary (combined Bt horizons 15 to 35 inches thick).

Bk--33 to 60 inches; pale brown (10YR 6/3) fine sandy loam, grayish brown (10YR 5/2) moist; moderate medium angular blocky structure; slightly hard, friable, nonsticky, and nonplastic; common very fine and fine roots throughout; common fine irregular light gray (10YR 7/2) carbonate threads throughout; violently effervescent; moderately alkaline (6 to 40 inches thick).

TYPE LOCATION: Campbell County, Wyoming; 1,300 ft north and 2,450 ft west of the southeast corner of Sec. 14, T. 46 N., R. 71 W.; 43 degrees 57 minutes 37 seconds north latitude and 105 degrees 21 minutes 7 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to secondary calcium carbonate accumulation ranges from 12 to 40 inches but is greater than 40 inches in some pedons. The moisture control section is dry for 60 consecutive days and 90 cumulative days between July 15 and October 25 in most years. Gravel content is typically less than 5 percent but ranges from 0 to 15 percent. Mean annual soil temperature ranges from 47 degrees to 53 degrees F.

The A horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry, 3 or 4 moist, and chroma of 2 through 4. Textures are sandy loam, fine sandy loam, or sandy clay loam. It is neutral or slightly alkaline.

The BA horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 or 3. Textures are sandy loam or fine sandy loam.

The Bt horizon has hue of 2.5YR or 5YR, which is stratified with subhorizons with hue of 2.5Y or 10YR. Both strata have value of 4 to 6 dry, 3 to 5 moist, and chroma of 3 to 6. Textures are typically sandy clay loam but some transitional horizons may be sandy loam. Reaction is neutral or slightly alkaline.

The Bk horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. Textures are sandy loam or fine sandy loam. Calcium carbonate equivalence ranges from 5 to 15 percent. In some pedons this horizon is below 40 inches. Some pedons have a C horizon with characteristics similar to the Bk except for the lack of secondary calcium carbonate.

COMPETING SERIES: These are the Barx, Clovis, Millett, Progresso, Selpats, Solirec, Threetop, Tuweep, and Wineg series. Barx, Millet, Progresso, and Tuweep soils are moist in some part of the moisture control section for more than 45 days between July 15 and October 15. Barx, Clovis, Solirex, and Wineg soils have calcic horizons with more than 15 percent calcium carbonate equivalent. Millett soils have solums less than 20 inches thick and skeletal material below the argillic horizon. Progresso and Threetop soils have a lithic contact at depths of 20 to 40 inches. Selpats soils have skeletal material within a depth of 40 inches. Solirex soils have Bk horizons more than 40 inches thick. Tuweep soils have pyroclastic material and have skeletal material in the lower part.

GEOGRAPHIC SETTING: Maysdorf soils are on gently to moderately sloping fan remnants, alluvial fans, terraces, ridges, and hills. Slopes range from 0 to 15 percent. These soils formed in stratified alluvium or aeolian deposits derived from mixed sources. The mean annual precipitation is 10 to 14 inches. The mean annual temperature is 45 to 50 degrees F. Elevation is 3,800 to 5,500 ft. The frost-free period is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Decolney and Potts soils. Decolney soils are noncalcareous. Potts soils have less than 35 percent fine or coarser sand in the argillic horizon.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderate permeability.

USE AND VEGETATION: These soils are used principally as native rangeland. They are also used for both irrigated and dryland crops in some places. Principal native vegetation is western wheatgrass, blue grama, needle-and-thread, prairie sandreed, and Indian ricegrass.

DISTRIBUTION AND EXTENT: North-central Wyoming. The series is of small extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Johnson County (Southern Johnson Area), Wyoming; 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 3 inches (A)
Argillic horizon - 7 to 33 inches (Bt1, Bt2)
Calcic horizon - 33 to 60 inches (Bk)

SIR - WY1072

MLRR - G

National Cooperative Soil Survey
U.S.A.

D7B.11 PUGSLEY SERIES

LOCATION PUGSLEY WY
Established Series
MCS-CJH
03/2003

The Pugsley series consists of moderately deep, well-drained soils that formed in material weathered from sedimentary rocks. Pugsley soils are on hills and ridges. Slopes range from 1 to 15 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

TYPICAL PEDON: Pugsley sandy loam-grassland. (Colors are for dry soil unless otherwise stated.)

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

BA--4 to 7 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; few faint clay bridges between sand grains; neutral (pH 7.2); clear smooth boundary (3 to 4 inches thick).

Bt--7 to 20 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky, and plastic; many prominent clay films on faces of peds; neutral (pH 7.2); clear smooth boundary (6 to 14 inches thick).

C--20 to 24 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; soft, loose, nonsticky, and nonplastic; neutral (pH 7.2); abrupt smooth boundary (3 to 6 inches thick).

Cr--24 inches; soft noncalcareous sandstone.

TYPE LOCATION: Johnson County, Wyoming; 500 ft north and 650 ft west of the southeast corner of sec. 3, T. 41 N., R. 77 W.; Taylor Ranch Quadrangle; 43 degrees 32 minutes 46 seconds north latitude and 106 degrees 5 minutes 20 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to the paralithic contact ranges from 20 to 40 inches. The soil is 80 to 100 percent base-saturated. Gravel ranges from 0 to 15 percent but is usually less than 5 percent. The mean annual soil temperature ranges from 47 to 54 degrees F. The moisture control section is dry for 60 consecutive days and 90 cumulative days between July 15 and October 25 in most years.

The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 3 to 5 moist, and chroma of 2 or 3. It typically has granular primary structure but has subangular blocky structure in some pedons. It is slightly acid to slightly alkaline.

The Bt horizon has hue of 2.5YR, 10YR, or 7.5YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4. This horizon is typically light sandy clay loam, but clay ranges from 18 to 35 percent, silt from 5 to 30 percent, and sand from 40 to 75 percent with more than 35 percent fine or coarser sand. It is neutral or slightly alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 or 4. Reaction is neutral to moderately alkaline.

COMPETING SERIES: These are the Balon, Blancot, Bowbac, Buckle, Cambria, Cushman, Decolney, Doakum, Forkwood, Gaddes, Gapmesa, Hagerman, Hagerwest, Hiland, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Quagwa, Redpen, Spangler, Spenlo, Sundance, Teckla, and Yenlo soils. Balon, Blancot, Buckle, Cambria, Decolney,

Doakum, Forkwood, Hiland, Los Alamos, Mentmore, Oelop, Olney, Palacid, Penistaja, Potts, Quagwa, Redpen, Spenlo, Sundance, Teckla, and Yenlo series are more than 60 inches deep to paralithic beds. Bowbac, Cushman, and Pokeman soils are calcareous at depths of less than 40 inches and have less than 35 percent fine or coarser sand. Gapmesa, Hagerman, and Hagerwest soils have a lithic contact at depths of less than 40 inches. Gaddes soils are intermittently moist in the moisture control section between July 15 and October 25.

GEOGRAPHIC SETTING: The Pugsley soils are on ridges and hills. Slopes range from 1 to 15 percent. Elevation is 4,000 to 5,500 ft. The soil formed in alluvium and residuum. The average annual precipitation is 10 to 14 inches of which about half falls in April, May, and early June. The average annual air temperature is 46 degrees F. The frost-free season is 110 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Decolney soils and the Maysdorf, Parmleed, Renohill, and Ulm soils. Maysdorf and Ulm soils are deeper than 60 inches to bedrock. Parmleed and Renohill soils are fine textured and have continuous horizons of secondary carbonate accumulation.

DRAINAGE AND PERMEABILITY: Well drained; medium or low runoff; moderate permeability.

USE AND VEGETATION: These soils are used principally for livestock grazing. Some small areas are used for dry cropland. Native vegetation is mainly needle-and-thread, prairie sandreed, and Indian ricegrass.

DISTRIBUTION AND EXTENT: North-central and northeastern Wyoming. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Johnson County (Southern Part), Wyoming; 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 4 inches (A)

Argillic horizon - 7 to 20 inches

Paralithic contact - 24 inches (Cr)

SIR - WY1144

National Cooperative Soil Survey

U.S.A.

D7B.12 SAMDAY SERIES

LOCATION SAMDAY WY+MT
Established Series
Rev. RLR/JAL
11/2005

The Samday series consists of well-drained soils that are very shallow or shallow to bedrock. They formed in residuum, slope alluvium, and colluvial slopewash derived from clay shale. Samday soils are on upland ridgetops, shoulders, and backslope positions of hills. Permeability is slow. Slopes range from 0 to 60 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Clayey, smectitic, calcareous, mesic, shallow Ustic Torriorthents

TYPICAL PEDON: Samday clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 2 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate coarse platy structure parting to weak fine granular; slightly hard, friable, moderately sticky, and moderately plastic; slightly effervescent, carbonates are disseminated; moderately alkaline (pH 8.0); gradual wavy boundary (2 to 6 inches thick).

Bw--2 to 10 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; strong coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm, very sticky, and very plastic; strongly effervescent, carbonates are disseminated; moderately alkaline (pH 8.2); gradual wavy boundary (0 to 8 inches thick).

BCky--10 to 18 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; hard, firm, very sticky, and very plastic; strongly effervescent, lime as common soft masses, filaments, and threads; few gypsum crystals; approximately 20 percent soft weathered

shale chips, which break down on pretreatment; moderately alkaline (pH 8.1); clear wavy boundary (4 to 10 inches thick).

Cr--18 to 60 inches; gray calcareous shale.

TYPE LOCATION: Converse County, Wyoming; 2,500 ft north and 1,600 ft west of the SE corner of Sec. 36, T. 37 N., R. 69 W.

RANGE IN CHARACTERISTICS: Depth to bedrock and the paralithic contact ranges from 6 to 20 inches. Depth to carbonates is 0 to 6 inches. The control section is a clay, heavy clay loam, or silty clay with 35 to 50 percent clay. Coarse fragments range from 0 to 35 percent but are soft shale chips and break down with pretreatment. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 4 mmhos throughout.

The A horizon has hue of 5Y through 10YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is clay loam, clay, silty clay loam, or silty clay. Reaction is typically neutral through moderately alkaline but may be strongly alkaline due to disturbance.

The Bw horizon, when present, has hue of 5Y through 10YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is clay, silty clay, silty clay loam, or clay loam. The base of any Bw horizon is typically 10 inches or less or, if deeper, is not a diagnostic cambic horizon. Reaction is slightly alkaline through strongly alkaline.

Some pedons have an AB horizon.

The BC or BCky horizon has hue of 5Y through 10YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is clay, silty clay, silty clay loam, or clay loam. Carbonates and gypsum appear to be autogenetic, but secondary accumulations are present in some pedons. Carbonates range from 4 to 10 percent. Reaction is slightly alkaline through strongly alkaline.

COMPETING SERIES: These are Cannonville, Danko, Midway, Orella, and Zyme series. Cannonville soils are dry for 65 to 75 percent of the time when the soil temperature at 20 inches is more than 41 degrees F. Danko soils have hue of 5YR or redder. Midway soils are not dry for 90 cumulative days or 60 consecutive days from July 15 to October 25. Orella soils have ESP of 8 to 30 in the AC and C horizons. Zyme soils do not have horizons of gypsum accumulation.

GEOGRAPHIC SETTING: Samday soils are on largely unstable upland ridgetops, shoulders, and backslopes of ridges and low hills. These soils formed in fine textured shale residuum, slope alluvium, and colluvial slopewash. Slopes are 0 to 45 percent. Elevation is 3,500 to 6,500 ft. Precipitation ranges from 10 to 17 inches with over half of the annual precipitation falling in each month of July, August, September, and October. The mean annual temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Orella, Savageton, Shingle, Worf, and Worfka soils. Orella soils have mixed mineralogy in the control section and have high sodium content. Savageton soils have a paralithic contact at depths of 20 to 40 inches. Shingle soils have loamy control sections. Worf and Worfka soils have argillic horizons. Worf soils also have loamy control sections.

DRAINAGE AND PERMEABILITY: Well drained; medium to rapid runoff; permeability is slow.

USE AND VEGETATION: These soils are dominantly used for grazing. Potential native vegetation is western wheatgrass, thickspike wheatgrass, green needlegrass, and bluebunch wheatgrass.

DISTRIBUTION AND EXTENT: Powder River Basin and adjacent areas of eastern Wyoming. Series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bozeman, Montana

SERIES ESTABLISHED: Converse County, Wyoming; 1983.

National Cooperative Soil Survey
U.S.A.

D7B.13 SAVAGETON SERIES

LOCATION SAVAGETON WY
Established Series
GFK/CAP/CJH
12/2005

The Savageton series consists of moderately deep, well-drained, slowly permeable soils. They formed in alluvium, colluvium, and residuum derived dominantly from shale on hills, ridges, fan remnants, fan piedmonts, and fan aprons. Slopes range from 0 to 30 percent. The average annual precipitation is about 13 inches, and the average annual air temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustic Haplocambids

TYPICAL PEDON: Savageton clay loam in an area of native rangeland on an 8 percent east-facing slope. (Colors are for dry soil unless otherwise stated.)

A--0 to 5 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, firm, moderately sticky, and moderately plastic; common fine roots; slightly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2); abrupt smooth boundary (3 to 6 inches thick).

Bw--5 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium and coarse subangular blocky structure; very hard, firm, moderately sticky, and moderately plastic; common fine roots; strongly effervescent, calcium carbonate disseminated; strongly alkaline (pH 8.6); clear smooth boundary (7 to 26 inches thick).

Bk--20 to 29 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, moderately sticky, and moderately plastic; few fine roots; strongly

effervescent; common medium irregularly shaped masses of calcium carbonate; moderately alkaline (pH 8.0); clear wavy boundary (6 to 23 inches thick).

Cr--29 to 60 inches; platy, calcareous shale.

TYPE LOCATION: Weston County, Wyoming; 1,320 ft east and 100 ft north of the SW corner of Sec. 10, T. 48 N., R. 66 W.; 44 degrees 9 minutes north latitude and 104 degrees 46 minutes 27 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to the base of the cambic horizon ranges from 13 to 30 inches but is typically greater than 20 inches. Because of surface recharge, the soils are more commonly calcareous throughout; but depth to continuous zones of carbonate accumulation (or Bk horizon) is 15 to 30 inches in most pedons. Depth to bedrock ranges from 20 to 40 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. Textures for the entire profile and each horizon are clay loam, clay, silty clay, or silty clay loam with 35 to 50 percent clay. Rock fragments range up to 5 percent.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 7 dry, 3 to 5 moist, and chroma of 2 to 4. Reaction is neutral to moderately alkaline.

The Bw or cambic horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. Reaction is slightly alkaline to strongly alkaline. Dry consistence is hard or very hard.

The Bk or C horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. Reaction is moderately alkaline or strongly alkaline. Calcium carbonate equivalent averages 5 to 14 percent, but some discontinuous strata exceed 14 percent in some pedons. The measured ESP is less than 15 percent, but field tests show reactions over 8.6 in many pedons.

The Cr horizon is soft, massive clay shale, which limits water intake and root growth. It forms a paralithic contact.

COMPETING SERIES: These are the Degator and Silhouette series. Degator soils have a frost-free period of less than 105 days. Silhouette soils have bedrock deeper than 60 inches.

GEOGRAPHIC SETTING: Savageton soils are on dissected fan piedmonts, fan aprons, ridges, and rolling hills controlled by bedrock at moderate depths. Slopes are 0 to 30 percent. Elevations are 3,500 to 6,000 ft. The average annual precipitation is 13 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The average annual air temperature ranges from 45 to 51 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Silhouette soils and the Bahl, Renohill, Samday, and Ulm series. Bahl and Samday soils lack cambic horizons. In addition, the Samday soils have bedrock at less than 20 inches. Renohill and Ulm soils have argillic horizons.

DRAINAGE AND PERMEABILITY: Well drained; medium to high runoff depending on slope; and slowly permeable.

USE AND VEGETATION: These soils are used for grazing by domestic livestock and wildlife. Principal native vegetation is western wheatgrass, sedge, blue grama, and cactus.

DISTRIBUTION AND EXTENT: Central and eastern Wyoming. It is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Converse County, Wyoming; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 5 inches (A)

Cambic horizon - 5 to 20 inches (Bw)

Paralithic contact - 29 inches (Cr)

SIR - WY0951

LRR - G

National Cooperative Soil Survey

U.S.A.

D7B.14 SHINGLE SERIES

LOCATION SHINGLE WY+CO MT NE NM SD UT
Established Series
Rev. PSD-MCS-JAL
11/2005

The Shingle series consists of well-drained soils that are very shallow or shallow to bedrock. They formed in residuum and colluvium derived from interbedded shale and sandstone or in alluvium from mudstone. Shingle soils are on bedrock controlled hillslopes and ridges. Slopes are 0 to 80 percent. The mean annual precipitation is about 13 inches, and the mean annual temperature is 45 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

TYPICAL PEDON: Shingle clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, moderately sticky, and moderately plastic; slightly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.0); clear smooth boundary (1 to 6 inches thick).

Bw--4 to 8 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; hard, friable, moderately sticky, and moderately plastic; slightly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary (0 to 5 inches thick).

C--8 to 15 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, variable, moderately sticky, and moderately plastic; slightly effervescent, lime disseminated; moderately alkaline (pH 8.2); clear wavy boundary (4 to 15 inches thick).

Cr--15 to 60 inches; soft, calcareous shale interbedded with lenses of soft sandstone.

TYPE LOCATION: Goshen County, Wyoming; near the NW corner of SE1/4, NE1/4 of Sec. 14, T. 22 N., R. 61 W.; 41 degrees 52 minutes 55 seconds north latitude and 104 degrees 9 minutes 15 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to soft bedrock and paralithic contact ranges from 4 to 20 inches. The mean annual soil temperature is 47 to 53 degrees F. These soils commonly are calcareous throughout, but some pedons are leached to 6 inches. The particle size control section averages 20 to 35 percent clay and has more than 15 percent but less than 35 percent fine or coarser sand. The soil is usually dry. The moisture control section is usually moist in April, May, and early June. It is dry for 60 consecutive days or more during the 90-day period following the summer solstice. EC is 0 to 2 mmhos throughout.

The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 3 through 6 moist, and chroma of 1 through 6. Reaction is neutral through strongly alkaline. Some pedons have a light gravel lag on the surface. Texture is loam, silt loam, clay loam, silty clay loam, cobbly loam, and gravelly clay loam. Rock fragments or shale channers range from 0 to 35 percent.

A Bw or AC horizon, when present, has the combined properties of the A and C horizons.

The C horizon has hue of 5Y through 7.5YR, value of 4 through 7 dry, 3 through 6 moist, and chroma of 1 through 6. It is loam, silt loam, clay loam, or silty clay loam. Rock fragments or shale channers range from 0 to 35 percent. Reaction is slightly alkaline through strongly alkaline.

COMPETING SERIES: These are the Canyon, Dulce (T), Epping, Eslendo, Gerst, Picante, Quarteles (T), Redarrow, Remorris, Sandoval, Taluce, and Tassel series. Canyon soils are somewhat excessively drained. Dulce, Tassel, and Taluce soils have less than 18 percent clay in the particle size control section. Epping soils have siltstone chips in the control section and contain a significant amount of glass shards. Eslendo, Quarteles, and Sandoval soils are dry in May and June. Gerst and Picante soils are not dry for 60 consecutive days during the three months following the summer solstice. Redarrow and Remorris soils have hue of 5YR or redder.

GEOGRAPHIC SETTING: The Shingle soils occur on all hillslope positions. Slopes are 0 to 80 percent. These soils formed in colluvium and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone. Elevation is 3,200 to 6,500 ft. The mean annual precipitation is about 10 to 14 inches, most of which falls in April, May, and June. The mean annual temperature is about 45 degrees F but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Kishona and Theedle soils. Kishona soils lack bedrock above a depth of 40 inches. Theedle soils have a paralithic contact at a depth of 20 to 40 inches. These soils usually occur on footslopes or toeslopes.

DRAINAGE AND PERMEABILITY: Well drained; medium or high runoff depending upon slope; moderate permeability.

USE AND VEGETATION: These soils are used for rangeland and wildlife habitat. Native vegetation consists of bluebunch wheatgrass, needle-and-thread, western wheatgrass, and blue grama.

DISTRIBUTION AND EXTENT: Basins and high plains of Colorado, Nebraska, South Dakota, Utah, and Wyoming. The series is extensive.

MLRA OFFICE RESPONSIBLE: Bozeman, Montana

SERIES ESTABLISHED: Johnson County, Wyoming, South Part; 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 4 inches (A)

Paralithic contact - 15 inches (Cr)

MLRR - G

SIR - WY0090, WY0678, WY0953, WY1284, WY1284

National Cooperative Soil Survey

U.S.A.

D7B.15 STONEHAM SERIES

LOCATION STONEHAM CO+WY
Established Series
Rev. AJC/JWB
02/2006

The Stoneham series consists of very deep, well-drained soils that formed in tertiary pedisediments and mixed aeolian material and alluvium or similar age materials. Stoneham soils are on hills and plains and alluvial fans and have slopes of 0 to 30 percent. The mean annual precipitation is about 36 centimeters (14 inches). Mean annual temperature is about 12 degrees C (53 degrees F).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs

TYPICAL PEDON: Stoneham loam - grassland. (Colors are for dry soil unless otherwise noted.)

A--0 to 8 centimeters (0 to 3 inches); brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; very friable, slightly sticky, and slightly plastic; common very fine and fine roots; neutral (pH 7.2); abrupt smooth boundary (8 to 10 centimeters [3 to 4 inches] thick).

Bt--8 to 15 centimeters (3 to 6 inches); grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm, slightly sticky, and slightly plastic; common very fine and fine roots, few fine pores; few faint clay films on faces of peds; slightly alkaline (pH 7.6); clear smooth boundary (8 to 23 centimeters [3 to 9 inches] thick).

Btk--15 to 25 centimeters (6 to 10 inches); pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky, and plastic; few

very fine and fine roots, few fine tubular pores; few faint patchy clay films on faces of peds; slightly effervescent, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary (0 to 10 centimeters [0 to 4 inches] thick).

Bk1--25 to 69 centimeters (10 to 27 inches); very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; few very fine and fine roots, common very fine and fine tubular pores; strongly effervescent, few fine filaments and soft masses of calcium carbonate; moderately alkaline (pH 8.4); gradual smooth boundary (25 to 51 centimeters [10 to 20 inches] thick).

Bk2--69 to 152 centimeters (27 to 60 inches); very pale brown (10YR 7/3) loam, light yellowish brown (10YR 6/4) moist; massive; soft, friable, slightly sticky, and slightly plastic; few very fine and fine roots, common very fine and fine tubular pores; strongly effervescent, few fine filaments and soft masses of calcium carbonate; strongly alkaline (pH 8.6).

TYPE LOCATION: Kit Carson County, Colorado; approximately 28.8 kilometers (18 mi) south of Flagler; 555 meters (1,820 ft) north and 229 meters (750 ft) west of the southeast corner of Sec. 36, T. 11 S., R. 51 W.; latitude 39 degrees, 2 minutes, 40 seconds north, and longitude 103 degrees, 3 minutes, 13 seconds west.

RANGE IN CHARACTERISTICS:

Mean annual soil temperature: 9 to 13 degrees C (48 to 55 degrees F)

Mean summer soil temperature: 15 to 22 degrees C (59 to 72 degrees F)

Depth to calcareous material: 8 to 26 centimeters (3 to 10 inches)

Depth to base of the Bt horizon: 15 to 38 centimeters (6 to 15 inches)

Weighted average content of organic carbon in the upper 38 centimeters (15 inches) exceeds .6 percent.

Sand/clay ratio ranges from about 1 to 3.

Content of coarse fragments ranges from 0 to 15 percent.

Soil temperature exceeds 5 degrees C (41 degrees F) at 51 centimeters (20 inches) approximately 210 to 240 days.

A horizon:
Hue: 2.5Y or 10YR
Value: 5 or 6, 3 or 4 moist
Chroma: 2 or 3
Structure: granular or crumb primary but subangular blocky in some pedons
This horizon: soft to slightly hard
Reaction: neutral to slightly alkaline

Bt horizon:
Hue: 2.5Y to 7.5YR
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 4
Structure: prismatic primary but subangular blocky structure in some pedons
Texture: clay loam, loam, or sandy clay loam
Clay content: 15 to 35 percent
Silt content: 10 to 50 percent
Sand content: 20 to 70 percent with more than 15 percent fine sand or coarser.
Reaction: neutral to slightly alkaline

Bk or C horizons:
Hue: 2.5Y to 7.5YR
Value: 6 or 7, 5 or 6 moist
Chroma: 3 or 4
Texture: loam, clay loam, and sandy clay loam
Reaction: moderately alkaline or strongly alkaline
Calcium carbonate equivalent: 5 to 15 percent

COMPETING SERIES: These are the Arnor, Arwite, Augustine, Bigbow, Bosonoak, Carri, Celacy, Celavar, Dalhart, Dermala, Elwop, Evpark, Flugle, Fort Collins, Gateson, Goesling, Iwela, Lykorly, Navajita, Nyjack, Oldwolf, Olnest, Orlie, Parkelei, Pinitos, Rauzi, Ribera, Rockybutte, Toluca, and Wagonhound series.

Arwite, Oldwolf, Olnest, Rauzi, and Rockybutte soils have calcium carbonate at greater than 25 centimeters (10 inches) of depth.

Bosonoak and Celavar soils are driest during May and June and are in the Aridic ustic moisture regime.

Augustine, Dalhart, Dermala, and Goesling soils have sola greater than 24 inches to the base of the Bt horizon.

Bigbow soils have a lithological discontinuity within 40 inches and the moisture control section is wetter during the months of May and June.

Carri, Evpark, Nyjack, and Ribera soils have a lithic contact above 40 inches.

Arnor, Celacy, Elwop, and Gateson soils have a paralithic contact.

Deekay and Wagonhound soils have calcium carbonate below 25 centimeters (10 inches).

Flugle soils have more than 35 percent fine sand and coarser in the particle-size control section.

Fort Collins soils contain 20 to 50 percent sand (more than 15 percent but less than 35 percent being fine sand or coarser)

Iwela soils have a lithologic discontinuity of stones at 26 inches and the moisture control section is dry in May and June.

Lykorly, Navajita, Orlie, Parkelei, and Pinitos soils have dry moisture control sections in May and June.

Toluca soils have a calcic horizons.

GEOGRAPHIC SETTING:

Landscape: hills and plains

Slopes: 0 to about 30 percent

Parent material: tertiary pedisediments of Ogallala and mixed aeolian material and alluvium of similar age

Mean annual precipitation: 33 to 43 centimeters (13 to 17 inches), 25 centimeters (10 inches) of which falls during April to September

Mean annual temperature: 7 to 12 degrees C (45 to 54 degrees F)

Mean summer temperature: 25 degrees C (77 degrees F)

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Fort Collins soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage: well drained

Runoff: high

Saturated hydraulic conductivity: moderately high

USE AND VEGETATION: These soils are used chiefly as native pastureland. Some of the nearly level areas are used for winter wheat. Native vegetation is principally short grass and some cactus.

DISTRIBUTION AND EXTENT: Wyoming and Eastern Colorado. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: The Akron Area, Colorado; 1942.

REMARKS: Diagnostic horizons and features recognized in this pedon:
Argillic horizon: 10 to 30 centimeters (4 to 12 inches)
Class is changed with this revision from Ustollic Haplargids to Aridic Haplustalfs. Last updated by the state 3/94.

Modified format by LRM in 10/2005 to include metric conversion and change permeability to saturated hydraulic conductivity.

National Cooperative Soil Survey
U.S.A.

D7B.16 TERRO SERIES

LOCATION TERRO WY
Established Series
GFK/CAP/CJH
12/2005

The Terro series consists of well-drained soils that are moderately deep to soft bedrock. They formed on gently to steeply sloping hills, ridges, fan remnants, terraces, and plateaus in residuum, alluvium, colluvial slopewash or aeolian materials derived primarily from soft sandstone. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 47 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, mesic Ustic Haplargids

TYPICAL PEDON: Terro sandy loam--on west-facing slope of 10 percent rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 6 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky, and nonplastic; many fine and very fine roots; neutral (pH 7.2); clear smooth boundary (4 to 6 inches thick).

Bt--6 to 20 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky, and nonplastic; many fine roots; common faint clay bridges between sand grains; slightly alkaline (pH 7.4); clear wavy boundary (6 to 14 inches thick).

Bk1--20 to 24 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, and nonplastic; few fine and medium roots; slightly effervescent, calcium carbonate disseminated and as few distinct masses; moderately alkaline (pH 8.0); clear wavy boundary (0 to 7 inches thick).

Bk2--24 to 34 inches; light gray (10YR 7/2) sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, nonsticky, and nonplastic; strongly effervescent, calcium carbonate disseminated and as common, distinct, irregularly shaped masses; moderately alkaline (pH 8.4); gradual wavy boundary (10 to 25 inches thick).

Cr--34 to 60 inches; soft, calcareous sandstone.

TYPE LOCATION: Weston County, Wyoming; 870 ft north and 150 ft east of the southwest corner of Sec. 27, T. 44 N., R. 68 W.; 43 degrees 45 minutes 24 seconds north latitude and 105 degrees 1 minute 9 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to horizons of continuous calcium carbonate accumulation ranges from 15 to 22 inches. Depth to the base of the argillic horizon is 10 to 22 inches. Depth to bedrock ranges from 20 to 40 inches. Rock fragments as channers range from 0 to 10 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 48 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry, 3 to 5 moist, and chroma 1 to 3. It has textures of sandy loam, fine sandy loam, or very fine sandy loam. Reaction is neutral or slightly alkaline.

The Bt horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 5 to 7 dry, 3 to 5 moist, and chroma of 2 to 4. It is sandy loam or fine sandy loam with clay ranging from 10 to 18 percent. Oriented clay occurs as bridges holding mineral grains together. Reaction is neutral or slightly alkaline.

The Bk horizon has hue of 7.5YR to 2.5Y, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. Texture is sandy loam, fine sandy loam, loamy sand, or loamy fine sand. Reaction is slightly alkaline to strongly alkaline.

The C horizon, when present, has hue of 10YR or 2.5Y, value of 5 or 6 dry, 4 or 5 moist, and chroma of 3 or 4. Texture is fine sandy loam, sandy loam, loamy sand, or loamy fine sand. Reaction is neutral or slightly alkaline. Calcium carbonate is 0 to 4 percent.

The Cr horizon is soft calcareous sandstone or sandstone interbedded with shale.

COMPETING SERIES: These are the Betonnie, Bijou, Tintero, and Vonalee series. It is assumed the Terry series is competing pending an update of the classification. Betonnie, Bijou, Tintero and Vonalee soils lack a paralithic contact at depths less than 40 inches. Terry soils are moist in some or all parts for 60 consecutive days following July 15 and are moist in some parts for at least 90 cumulative days when the soil temperature at a depth of 20 inches is 41 degrees F or more.

GEOGRAPHIC SETTING: The Terro soils are on nearly level to steeply sloping hills, ridges, fan remnants, terraces, and plateaus. Slopes range from 0 to 30 percent. The soils formed in residuum, alluvium, and colluvium. Elevation is 3,600 to 6,500 ft. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free season is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Vonalee and the Keeline, Taluce, and Turnercrest soils. Keeline soils lack a paralithic contact at depths of less than 40 inches. Taluce and Turnercrest lack an argillic horizon and are calcareous throughout.

DRAINAGE AND PERMEABILITY: Well drained; low to high runoff; moderately rapid permeability.

USE AND VEGETATION: These soils are used mainly as rangeland. Native vegetation consists of needle-and-thread, blue grama, prairie sandreed, and threadleaf sedge.

DISTRIBUTION AND EXTENT: Powder River Basin and adjacent areas of eastern Wyoming. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Weston County, Wyoming; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 6 inches (A)
Argillic horizon - 6 to 20 inches (Bt)
Paralithic contact - 34 inches (Cr)

SIR - WY1148

MLRR - G

National Cooperative Soil Survey
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D7B.17 THEEDLE SERIES

LOCATION THEEDLE WY
Established Series
GFK/CJH
06/2002

The Theedle series consists of well-drained soils that are moderately deep to soft bedrock. They formed in residuum and slope alluvium weathered from soft sandstone. The Theedle soils are on hills, ridges, and fan remnants. Slopes are 0 to 75 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

TYPICAL PEDON: Theedle loam--on west-facing hill footslope of 6 percent rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak granular structure; slightly hard, friable, nonsticky, and nonplastic; many very fine, fine, and medium roots; slightly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.7); clear smooth boundary (0 to 5 inches thick).

BCk--4 to 8 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, nonsticky, and nonplastic; common very fine, fine, and medium roots; violently effervescent; calcium carbonate disseminated and as few fine filaments; moderately alkaline (pH 7.9); clear smooth boundary (4 to 10 inches thick).

C--8 to 28 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky, and nonplastic; few fine and very fine roots; violently effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2); clear smooth boundary (14 to 26 inches thick).

Cr--28 to 60 inches; light gray, soft, calcareous sandstone.

TYPE LOCATION: Weston County, Wyoming; about 3,500 ft west and 100 ft south of the NE corner of sec. 35, T. 44 N., R. 67 W.

RANGE IN CHARACTERISTICS: Depth to soft, gray, calcareous sandstone or sandy shale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is loam, clay loam, or fine sandy loam. Reaction ranges from neutral to moderately alkaline. EC is 0 to 2 mmhos/cm.

The BCk (or AC and Bw, when present) has hue of 10YR or 2.5Y, value of 5 or 6 dry, 3 to 5 moist, and chroma of 2 to 4. Texture is loam, clay loam, or sandy clay loam. Reaction is slightly alkaline to strongly alkaline. EC is 0 to 4 mmhos/cm.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 dry, 4 to 7 moist, and chroma of 2 to 5. Texture is loam, clay loam, or sandy clay loam. Reaction is slightly alkaline to strongly alkaline. EC is less than 8 mmhos/cm. Carbonates usually average between 5 and 14 percent with slight segregation in some pedons.

COMPETING SERIES: These are the El Rancho, Kishona, Mikim, Neville, Paradox, Pojoaque, Shavano, Thedalund, and Tsosie series. It is assumed the El Rancho, Neville, Pojoaque, and Shavano series are competing pending an update of the classification. The El Rancho, Kishona, Mikim, Neville, and Pojoaque soils lack a paralithic contact at depths less than 40 inches. Paradox soils have hue of 5YR or redder. Shavano soils have more than 35 percent fine sand or coarser in the particle-size control section. Thedalund and Tsosie soils are intermittently moist in some parts of the moisture control section from July 15 to October 25. Thedalund soils also have soil temperatures warmer than 41 degrees F for 195 to 210 days.

GEOGRAPHIC SETTING: Theedle soils are on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hillslope profile but typically are on the lower shoulder, footslope, and toeslope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 ft. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Kishona soils and the Cambria, Cushman, Forkwood, Shingle, Taluce, and Zigweid soils. Cambria, Cushman, and Forkwood soils have argillic horizons. Kishona soils are very deep. Shingle and Taluce soils have soft bedrock above 20 inches. Zigweid soils have cambic horizons and lack bedrock above 60 inches. Cambria, Forkwood, Kishona, and Zigweid soils occur on backslopes and footslopes on hills and ridges. Cushman, Shingle, and Taluce soils occur on similar positions.

DRAINAGE AND PERMEABILITY: Well drained; slow to rapid runoff; moderate permeability.

USE AND VEGETATION: They are used principally for rangeland. Native vegetation is bluebunch wheatgrass, green needlegrass, needle-and-thread, and big sagebrush.

DISTRIBUTION AND EXTENT: Central and east-central Wyoming. The soil is moderately extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Weston County, Wyoming; 1983.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 8 inches (A, BCk)
Paralithic contact - 28 inches (Cr)
Ustic subgroup - Aridic moisture regime bordering on Ustic.

SIR - WY0958

National Cooperative Soil Survey
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D7B.18 ULM SERIES

LOCATION ULM WY+MT
Established Series
CAP-CJH
12/2005

The Ulm series consists of very deep, well-drained soils that formed in calcareous alluvium derived from sedimentary rock. Ulm soils are on relict terraces, alluvial fans, fan remnants, plateaus, ridges, and hills. Slopes are 0 to 18 percent. The mean annual precipitation is about 12 inches, and the mean air annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustic Haplargids

TYPICAL PEDON: Ulm clay loam--rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; strong fine granular structure; slightly hard, friable, sticky, and plastic; many fine and few medium roots; neutral (pH 7.0); clear smooth boundary (2 to 5 inches thick).

Bt--4 to 15 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky, and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; neutral (pH 7.2); clear wavy boundary (6 to 23 inches thick).

Btk--15 to 25 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium prismatic parting to strong medium angular blocky structure; very hard, firm, very sticky, and very plastic; common fine and few medium roots; common distinct clay films on faces of peds; slightly effervescent; calcium carbonate mostly disseminated with few prominent masses; slightly alkaline (pH 7.6); clear wavy boundary (3 to 21 inches thick).

Bk1--25 to 33 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky, and plastic; few fine and medium roots; strongly effervescent; calcium carbonate as common distinct masses, seams, and streaks; moderately alkaline (pH 8.2); clear wavy boundary.

Bk2--33 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky, and plastic; calcium carbonate as common distinct masses, seams, and streaks; 5 percent partially weathered shale and sandstone channers; moderately alkaline (pH 8.4).

TYPE LOCATION: Campbell County, Wyoming; 2,300 ft west and 2,500 ft north of the southeast corner of Sec. 21, T. 48 N., R. 72 W.; 44 degrees 7 minutes 17 seconds north latitude and 105 degrees 30 minutes 45 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to calcareous material ranges from 12 to 33 inches. Rock fragments range from 0 to 15 percent channers. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 3 to 5 moist, and chroma of 1 to 4. Texture is loam or clay loam. It usually has granular structure but has subangular blocky structure in some pedons. This horizon is soft or slightly hard. Reaction is neutral or slightly alkaline.

The Bt horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4. Where colors are dark enough to be mollic the values are derived from parent material weathered from dark colored shales. Texture is usually clay loam, silty clay loam, silty clay, or clay with clay ranging from 35 to 50 percent, silt from 10 to 40 percent, and sand from 15 to 50 percent with more than 15 percent fine sand or coarser. This horizon usually has prismatic

structure but has angular or subangular blocky structure in some pedons. Reaction is neutral to moderately alkaline.

The Btk horizon has hue of 5Y, 2.5Y, or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture is clay, clay loam, silty clay, or silty clay loam. Reaction is slightly alkaline or moderately alkaline. The calcium carbonate equivalent ranges from 6 to 12 percent.

The Bk horizon has hue of 5Y, 2.5Y, or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture is clay loam, silty clay loam, silty clay, sandy clay loam, loam, or clay. It has 6 to 15 percent calcium carbonate equivalent. Reaction is moderately alkaline or strongly alkaline. Some areas have a sandy or gravelly substratum below 40 inches.

Some pedons have a C horizon.

COMPETING SERIES: These are the Agua Fria, Arp, Bessemer, Falfa, Manzanola, Mughouse, Rencalson, Renohill, Winklo, and Wyarno series. Agua Fria, Arp, and Falfa soils have hue of 7.5Y or redder below the A horizon. Arp, Mughouse, Rencalson, Renohill, and Winklo soils have either a lithic or a paralithic contact at depths of 20 to 40 inches. Bessemer soils have more than 35 percent rock fragments in the Bk horizon. Manzanola soils are calcareous below depths of 0 to 5 inches. Wyarno soils have a solum that is less than 15 inches to the base of the B3 horizon or less than 10 inches to the base of the B2t horizon.

GEOGRAPHIC SETTING: Ulm soils are on relict alluvial terraces, alluvial fans, fan remnants, plateaus, and footslopes and toeslopes of hills. Slopes are 0 to 18 percent. The soil formed in fine and medium textured alluvium derived from interbedded shales and agrillaceous sandstone. Elevations are 3,500 to 6,500 ft. The mean annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature ranges from 46 to 51 degrees F. The frost-free season is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Renohill soils and the Bidman, Cushman, Forkwood, Parmleed, Samday, and Savageton soils. Bidman and Parmleed soils have a greater than 15 percent increase in clay between the E and Bt horizons within a vertical distance of an inch or less. Cushman and Forkwood soils have a fine loamy particle size control section. Samday soils are shallow. Savageton soils have a cambic horizon and are calcareous throughout.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderate to slow permeability.

USE AND VEGETATION: These soils are utilized mostly for livestock grazing. Some areas are used for dry farming of small grains. Native vegetation is mainly western wheatgrass, blue grama, and big sagebrush.

DISTRIBUTION AND EXTENT: Eastern and central Wyoming, Montana, and Colorado. This soil is extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Sheridan County, Wyoming; 1932.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 4 inches (A)
Argillic horizon - 4 to 25 inches (Bt,Btk)

SIR - WY1150

LRR - G

National Cooperative Soil Survey

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ADDENDUM D7C:

ANALYTICAL RESULTS AND REPORT

Analytical Results and Report for the Nichols Ranch Unit

LABORATORY ANALYTICAL REPORT

Client: TRC - Mariah Assoc
Project: Nichols Ranch 424
Workorder: C06120608

Report Date: 01/10/07
Date Received: 12/13/06

Sample ID	Client Sample ID	Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
		Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C06120608-001	NNW	0-5	0.58	42.2	7.2	2.5	0.98	0.04	0.03	0.006	< 0.20	49	29	22	L
C06120608-002	NNW	5-22	0.39	54.9	8.0	2.6	1.8	0.17	0.12	0.006	< 0.20	36	40	24	L
C06120608-003	NNW	22-36	0.40	60.1	8.2	1.8	2.8	0.61	0.40	< 0.005	< 0.20	26	46	28	CL
C06120608-004	NNW	36-42	0.33	50.8	8.4	1.1	2.0	1.4	1.14	< 0.005	0.28	38	38	24	L
C06120608-005	NNW	42-57	0.84	56.0	8.6	2.2	3.7	3.7	2.15	< 0.005	0.55	35	42	23	L
C06120608-006	NNE	0-2	0.80	61.9	8.0	7.9	2.3	0.14	0.06	0.007	0.32	37	37	26	L
C06120608-007	NNE	2-15	0.54	62.5	8.0	3.9	2.3	0.22	0.13	< 0.005	0.27	48	28	24	L
C06120608-008	NNE	15-30	0.40	51.7	8.4	1.5	1.6	1.6	1.28	< 0.005	0.32	41	33	26	L
C06120608-009	NNE	30-40	0.56	48.4	8.4	1.7	1.4	3.9	3.16	< 0.005	0.72	40	31	29	CL
C06120608-010	NNE	40-52	3.36	56.8	8.1	25	14	12	2.74	0.031	0.61	37	34	29	CL
C06120608-011	NNE	52-60	4.32	50.5	8.0	34	15	16	3.17	0.179	< 0.20	57	31	12	SL
C06120608-012	North	0-4	0.28	38.7	7.1	2.1	1.3	0.18	0.14	< 0.005	0.30	58	21	21	SCL
C06120608-013	North	4-19	0.22	52.2	7.5	1.7	1.1	0.18	0.15	< 0.005	0.43	60	22	18	SL
C06120608-014	North	19-24	0.32	47.3	8.0	2.3	1.5	0.34	0.25	< 0.005	0.34	67	15	18	SL
C06120608-015	North	24-36	0.32	43.8	8.3	2.0	1.8	0.46	0.34	< 0.005	0.25	70	16	14	SL
C06120608-016	North	36-52	0.34	45.0	8.5	1.4	1.8	1.3	1.00	< 0.005	0.28	55	35	10	SL
C06120608-017	North	52-60	0.53	48.4	8.6	1.2	2.1	3.2	2.47	< 0.005	0.62	49	31	20	L
C06120608-018	Middle	0-4	0.53	43.9	6.5	3.7	2.2	0.20	0.12	< 0.005	0.49	54	25	21	SCL
C06120608-019	Middle	4-17	0.38	50.3	7.6	2.7	1.8	0.50	0.33	< 0.005	0.33	28	42	30	CL
C06120608-020	Middle	17-23	0.52	64.8	8.0	2.9	2.3	1.1	0.66	< 0.005	0.24	40	34	26	L
C06120608-021	Middle	23-40	0.54	56.4	8.2	2.1	2.6	2.0	1.32	< 0.005	0.27	46	33	21	L
C06120608-022	Middle	40-52	0.98	57.5	8.3	2.7	4.2	4.0	2.18	< 0.005	0.52	43	36	21	L
C06120608-023	Middle	52-60	1.66	56.0	7.9	4.9	7.1	6.4	2.64	0.023	1.1	23	45	32	CL
Suitable			<8	25-80	5.5-8.5				<10	<0.1	<5.0				

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LABORATORY ANALYTICAL REPORT

Client:	TRC - Mariah Assoc	**Report Date:**	01/10/07
Project:	Nichols Ranch 424	**Date Received:**	12/13/06
Workorder:	C06120608		

		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**
C06120608-001	NNW	0-5	1.3	2.1
C06120608-002	NNW	5-22	1.6	
C06120608-003	NNW	22-36	2.6	
C06120608-004	NNW	36-42	1.7	
C06120608-005	NNW	42-57	< 1.0	
C06120608-006	NNE	0-2	2.7	2.6
C06120608-007	NNE	2-15	2.0	
C06120608-008	NNE	15-30	< 1.0	
C06120608-009	NNE	30-40	< 1.0	
C06120608-010	NNE	40-52	< 1.0	
C06120608-011	NNE	52-60	1.6	
C06120608-012	North	0-4	< 1.0	2.5
C06120608-013	North	4-19	< 1.0	
C06120608-014	North	19-24	1.2	
C06120608-015	North	24-36	< 1.0	
C06120608-016	North	36-52	< 1.0	
C06120608-017	North	52-60	< 1.0	
C06120608-018	Middle	0-4	< 1.0	3.2
C06120608-019	Middle	4-17	1.4	
C06120608-020	Middle	17-23	5.0	
C06120608-021	Middle	23-40	< 1.0	
C06120608-022	Middle	40-52	< 1.0	
C06120608-023	Middle	52-60	< 1.0	
Suitable			< 25	

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ANALYTICAL SUMMARY REPORT

January 10, 2007

TRC - Mariah Assoc
605 Skyline Dr
Laramie, WY 82070

Workorder No.: C06120608

Project Name: Nichols Ranch 424

Energy Laboratories, Inc. received the following 23 samples from TRC - Mariah Assoc on 12/13/2006 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C06120608-001	NNW [0-5]	12/06/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture
C06120608-002	NNW [5-22]	12/06/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120608-003	NNW [22-36]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-004	NNW [36-42]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-005	NNW [42-57]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-006	NNE [0-2]	12/06/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture

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C06120608-007 NNE [2-15]	12/06/06 00:00 12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120608-008 NNE [15-30]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-009 NNE [30-40]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-010 NNE [40-52]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-011 NNE [52-60]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-012 North [0-4]	12/06/06 00:00 12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture
C06120608-013 North [4-19]	12/06/06 00:00 12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120608-014 North [19-24]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-015 North [24-36]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-016 North [36-52]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-017 North [52-60]	12/06/06 00:00 12/13/06	Soil	Same As Above
C06120608-018 Middle [0-4]	12/06/06 00:00 12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture

D7C-6

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C06120608-019	Middle [4-17]	12/06/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120608-020	Middle [17-23]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-021	Middle [23-40]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-022	Middle [40-52]	12/06/06 00:00	12/13/06	Soil	Same As Above
C06120608-023	Middle [52-60]	12/06/06 00:00	12/13/06	Soil	Same As Above

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative or Report.

If you have any questions regarding these tests results, please call.

Report Approved By: R.A. [signature]

D7C-7

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Energy Laboratories, Inc.

Sample Receipt Checklist

Client Name TRC - Mariah Assoc

Date and Time Received: 12/13/2006 17:20:00

Work Order Number C06120608

Received by bk

Login completed by: Tim Hollen 12/13/2006 17:20:0

Signature | Date

Reviewed by _____

Initials | Date

Carrier name: Action Cargo

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
Samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	4 °C Soil
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Adjusted? _____ Checked by _____

Contact and Corrective Action Comments:

None

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Date: *10-Jan-07*

CLIENT: TRC - Mariah Assoc
Project: Nichols Ranch 424
Sample Delivery Group: C06120608

CASE NARRATIVE

THIS IS THE FINAL PAGE OF THE LABORATORY ANALYTICAL REPORT

BRANCH LABORATORY LOCATIONS
eli-b - Energy Laboratories, Inc. - Billings, MT
eli-f - Energy Laboratories, Inc. - Idaho Falls, ID
eli-g - Energy Laboratories, Inc. - Gillette, WY
eli-h - Energy Laboratories, Inc. - Helena, MT
eli-r - Energy Laboratories, Inc. - Rapid City, SD
eli-t - Energy Laboratories, Inc. - College Station, TX

ORIGINAL SAMPLE SUBMITTAL(S)
All original sample submittals have been returned with the data package. A copy of the submittal(s) has been included and tracked in the data package.

SUBCONTRACTING ANALYSIS
Subcontracting of sample analyses to an outside laboratory may be required. If so, ENERGY LABORATORIES will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

SAMPLE TEMPERATURE COMPLIANCE: 4°C (±2°C)
Temperature of samples received may not be considered properly preserved by accepted standards. Samples that are hand delivered immediately after collection shall be considered acceptable if there is evidence that the chilling process has begun.

CERTFICATIONS:
USEPA: WY00002
FL-DOH NELAC: E87641
Arizona: AZ0699
California: 02118CA
Oregon: WY200001
Utah: 3072350515
Virginia: 00057
Washington: C1903

ENERGY LABORATORIES, INC. - CASPER,WY certifies that certain method selections contained in this report meet requirements as set forth by the above accrediting authorities. Some result requested by the client may not be covered under these certifications. All analysis data to be submitted for regulatory enforcement should be certified in the sample state of origin. Please verify ELI's certification coverage by visiting www.energylab.com

PCB ANALYSIS USING EPA 505
Data reported by ELI using EPA method 505 reflects the results for seven individual Aroclors. When the results for all seven are ND (not detected), the sample meets EPA compliance criteria for PCB monitoring.

ELI appreciates the opportunity to provide you with this analytical service. For additional information and services visit our web page www.energylab.com.

The total number of pages of this report are indicated by the page number located in the lower right corner.

D7C-9

Analytical Results and Report for the Hank Unit

LABORATORY ANALYTICAL REPORT

Client: TRC - Mariah Assoc
Project: Hank Unit 424
Workorder: C06120599

Report Date: 01/05/07
Date Received: 12/13/06

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
Sample ID	Client Sample ID	Depth (in)	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C06120599-001	HNE	0-3	0.55	53.9	6.8	5.9	1.4	0.15	0.08	0.011	0.38	38	32	30	CL
C06120599-002	HNE	3-9	0.69	47.5	7.2	7.0	1.3	0.24	0.12	0.021	0.22	57	20	23	SCL
C06120599-003	HNE	9-30	0.35	43.1	7.7	3.6	0.74	0.22	0.15	0.012	< 0.20	60	19	21	SCL
C06120599-004	HNE	30-39	0.42	56.3	7.8	3.9	0.84	0.59	0.39	0.028	< 0.20	42	28	30	CL
C06120599-005	HNE	39-60	0.76	65.5	8.0	7.1	1.6	0.98	0.47	0.047	0.26	30	28	42	C
C06120599-006	HNW	0-4	0.50	60.5	7.0	4.6	1.5	0.24	0.14	0.010	0.37	33	35	32	CL
C06120599-007	HNW	4-12	0.61	61.1	7.4	5.2	1.5	0.33	0.18	0.006	0.34	31	30	39	CL
C06120599-008	HNW	12-27	0.53	68.2	7.8	3.7	1.3	0.69	0.44	0.013	0.42	15	34	51	C
C06120599-009	HNW	27-40	0.61	70.8	8.0	4.1	1.5	1.4	0.86	0.049	0.36	26	39	35	CL
C06120599-010	HNW	40-52	1.40	64.5	8.0	11	4.4	2.1	0.76	0.159	0.27	39	15	46	C
C06120599-011	HNW	52-60	1.62	54.9	8.0	13	5.7	2.1	0.69	0.150	0.24	39	31	30	CL
C06120599-012	HSE	0-6	0.38	68.3	7.1	3.3	1.2	0.11	0.07	0.012	0.47	22	35	43	C
C06120599-013	HSE	6-12	0.42	48.4	7.5	3.9	1.0	0.09	0.06	0.006	< 0.20	53	20	27	SCL
C06120599-014	HSE	12-20	0.40	64.0	7.7	3.5	0.97	0.10	0.06	0.009	0.20	29	35	36	CL
C06120599-015	HSE	20-28	0.51	50.8	7.9	4.2	1.3	0.14	0.08	0.008	< 0.20	50	25	25	SCL
C06120599-016	HSE	28-42	0.40	54.9	7.9	3.1	1.1	0.29	0.20	0.010	< 0.20	31	34	35	CL
C06120599-017	HSE	42-52	0.48	65.5	8.0	3.5	1.3	0.63	0.41	0.028	0.26	28	33	39	CL
C06120599-018	HSE	52-57	0.90	50.8	8.0	7.0	2.6	1.1	0.49	0.035	< 0.20	40	30	30	CL
Suitable			< 8	25-90	5.5-8.5				< 10	< 0.1	< 5.0				

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LABORATORY ANALYTICAL REPORT

Client: TRC - Mariah Assoc
Project: Hank Unit 424
Workorder: C06120599

Report Date: 01/05/07
Date Received: 12/13/06

		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C06120599-001	HNE	0-3	1.3	3.8
C06120599-002	HNE	3-9	3.6	
C06120599-003	HNE	9-30	1.5	
C06120599-004	HNE	30-39	1.8	
C06120599-005	HNE	39-60	3.3	
C06120599-006	HNW	0-4	3.4	4.0
C06120599-007	HNW	4-12	5.2	
C06120599-008	HNW	12-27	6.6	
C06120599-009	HNW	27-40	3.9	
C06120599-010	HNW	40-52	2.6	
C06120599-011	HNW	52-60	1.0	
C06120599-012	HSE	0-6	5.6	4.4
C06120599-013	HSE	6-12	5.6	
C06120599-014	HSE	12-20	6.1	
C06120599-015	HSE	20-28	1.7	
C06120599-016	HSE	28-42	1.6	
C06120599-017	HSE	42-52	3.2	
C06120599-018	HSE	52-57	5.0	

DTC-12

Suitable <25

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Track#C06120599 Page

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ANALYTICAL SUMMARY REPORT

January 05, 2007

TRC - Mariah Assoc
605 Skyline Dr
Laramie, WY 82070

Workorder No.: C06120599

Project Name: Hank Unit 424

Energy Laboratories, Inc. received the following 18 samples from TRC - Mariah Assoc on 12/13/2006 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C06120599-001	HNE [0-3]	12/05/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture Sodium Adsorption Ratio in Soil
C06120599-002	HNE [3-9]	12/05/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture Sodium Adsorption Ratio in Soil
C06120599-003	HNE [9-30]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-004	HNE [30-39]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-005	HNE [39-60]	12/05/06 00:00	12/13/06	Soil	Same As Above

D7c-13

C06120599-007 HNW [4-12]	12/05/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120599-008 HNW [12-27]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-009 HNW [27-40]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-010 HNW [40-52]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-011 HNW [52-60]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-012 HSE [0-6]	12/05/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Organic Matter Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Total Organic Matter Prep Particle Size Analysis / Texture
C06120599-013 HSE [6-12]	12/05/06 00:00	12/13/06	Soil	Saturated Paste Electrical Conductivity Selenium, ABDTPA Extractable Metals, CaCl2 Extractable Metals, Soluble Saturation Percentage Saturated Paste pH ABDTPA Soil Extraction CaCl2 Hot Water Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Particle Size Analysis / Texture
C06120599-014 HSE [12-20]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-015 HSE [20-28]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-016 HSE [28-42]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-017 HSE [42-52]	12/05/06 00:00	12/13/06	Soil	Same As Above
C06120599-018 HSE [52-57]	12/05/06 00:00	12/13/06	Soil	Same As Above

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative or Report.

If you have any questions regarding these tests results, please call.

Report Approved By: R.A. Garling
Roger Garling
Laboratory Supervisor

07C-14

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Toll Free 888.235.0515 • 307.235.0515 • Fax 307.234.1639 • casper@energylab.com • www.energylab.com

Energy Laboratories, Inc.

Sample Receipt Checklist

Client Name TRC - Mariah Assoc

Date and Time Received: 12/13/2006 17:20:00

Work Order Number C06120599

Received by bk

Login completed by: Tim Hollen 12/13/2006 17:20:0

Signature | Date

Reviewed by _____

Initials | Date

Carrier name: Action Cargo

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
Samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	4 °C Soil
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Adjusted? _____ Checked by _____

Contact and Corrective Action Comments:

None

DTC-15

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Date: 05-Jan-07

CLIENT: TRC - Mariah Assoc
Project: Hank Unit 424
Sample Delivery Group: C06120599

CASE NARRATIVE

THIS IS THE FINAL PAGE OF THE LABORATORY ANALYTICAL REPORT

BRANCH LABORATORY LOCATIONS
eli-b - Energy Laboratories, Inc. - Billings, MT
eli-f - Energy Laboratories, Inc. - Idaho Falls, ID
eli-g - Energy Laboratories, Inc. - Gillette, WY
eli-h - Energy Laboratories, Inc. - Helena, MT
eli-r - Energy Laboratories, Inc. - Rapid City, SD
eli-t - Energy Laboratories, Inc. - College Station, TX

ORIGINAL SAMPLE SUBMITTAL(S)
All original sample submittals have been returned with the data package. A copy of the submittal(s) has been included and tracked in the data package.

SUBCONTRACTING ANALYSIS
Subcontracting of sample analyses to an outside laboratory may be required. If so, ENERGY LABORATORIES will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

SAMPLE TEMPERATURE COMPLIANCE: 4°C (±2°C)
Temperature of samples received may not be considered properly preserved by accepted standards. Samples that are hand delivered immediately after collection shall be considered acceptable if there is evidence that the chilling process has begun.

CERTFICATIONS:
USEPA: WY00002
FL-DOH NELAC: E87641
Arizona: AZ0699
California: 02118CA
Oregon: WY200001
Utah: 3072350515
Virginia: 00057
Washington: C1903

ENERGY LABORATORIES, INC. - CASPER,WY certifies that certain method selections contained in this report meet requirements as set forth by the above accrediting authorities. Some result requested by the client may not be covered under these certifications. All analysis data to be submitted for regulatory enforcement should be certified in the sample state of origin. Please verify ELI's certification coverage by visiting www.energylab.com

PCB ANALYSIS USING EPA 505
Data reported by ELI using EPA method 505 reflects the results for seven individual Aroclors. When the results for all seven are ND (not detected), the sample meets EPA compliance criteria for PCB monitoring.

ELI appreciates the opportunity to provide you with this analytical service. For additional information and services visit our web page www.energylab.com.

The total number of pages of this report are indicated by the page number located in the lower right corner.

DTC-116

ADDENDUM D7D:

NEGATIVE PRIME FARMLAND DESIGNATION LETTER

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Natural Resources Conservation Service
Federal Building
100 East B Street, Room 3124
P.O. Box 33124
Casper, WY 82602

Date:

Jamie Eberly
BKS Environmental Associates
P.O. Box3467
Gillette, WY 82717

Dear Ms. Eberly,

The Natural Resources Conservation Service has reviewed the list of the legal descriptions on the Hank Unit.

There is no prime farm land or agricultural land of state wide importance contained within these legal descriptions.

If you have any questions, or need to discuss this comment with us, please contact either myself at 307-233-6750 or please contact Doug Gasseling, Conservation Agronomist, Cheyenne, Wyoming, at 307-772-2320, ext. 101.

Sincerely,

[signature] acting for:

ADOLFO PEREZ
State Conservationist

United State Department of Agriculture

Natural Resources Conservation Service

350 Nolan Ave. (PO Box48)
Kaycee, WY 82639
(307) 738-2321

February 5, 2007

Jamie Eberly
BKS Environmental Associate, Inc.
PO Box 3467
Gillette, WY 82717-3467

Dear Jamie,

As per your request I have completed a Prime and Other Farmlands Determination on the W1/2 of Section 17, NW1/4 Section 20, and the SW1/4 of Section 8 Township 45 North, Range 76 West. From your soils map that you have provided there are no soils in this category. Please see the list below for Prime and Other Farmlands in Southern Johnson County.

Prime and Other Important Farmlands
Johnson County, Wyoming, Southern Part

Map Symbol	*Map unit name*	*Farmland classification*
Be	Barnum silt loam	Prime farmland if irrigated
Bf	Barnum silt loam, sandy subsoil variant	Prime farmland if irrigated
FcA	Fort Collins loam, 0 to 3 percent slopes	Prime farmland if irrigated
FcB	Fort Collins loam, 3 to 6 percent slopes	Prime farmland if irrigated
Gd	Glenberg fine sandy loam	Prime farmland if irrigated
He	Haverson silt loam	Prime farmland if irrigated
Hg	Haverson clay loam	Prime farmland if irrigated
Hm	Haverson silt loam, sandy subsoil variant	Prime farmland if irrigated
KdA	Kim loam, 0 to 3 percent slopes	Prime farmland if irrigated
KdB	Kim loam, 3 to 6 percent slopes	Prime farmland if irrigated
SsA	Stoneham loam, 0 to 3 percent slopes	Prime farmland if irrigated
SsB	Stoneham loam, 3 to 6 percent slopes	Prime farmland if irrigated
ZgA	Zigweid loam, 0 to 3 percent slopes	Prime farmland if irrigated
ZgB	Zigweid loam, 3 to 6 percent slopes	Prime farmland if irrigated

Sincerely,

Allison

Allison McKenzie
District Conservationist
Kaycee Field Office

D70-3

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: DRAWING NO.: EXHIBIT D7-1, "NICHOLS RANCH UNIT SOILS"

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. EXHIBIT D7-1

D-01

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D-02

APPENDIX D8:

VEGETATION

November 2007

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LIST OF ABBREVIATIONS AND ACRONYMS

GIS	Geographic information system
GPS	Global positioning system
ISR	In Situ Recovery
NRCS	Natural Resources Conservation Service
T&E	Threatened and endangered
TRC	TRC Environmental Corporation
USGS	U.S. Geological Survey
WDEQ/LQD	Wyoming Department of Environmental Quality, Land Quality Division

D8.1.0 INTRODUCTION

Baseline vegetation studies of the Nichols Ranch ISR Project area were conducted in June and July 2006 by TRC Environmental Corporation (TRC) in accordance with a vegetation study plan approved by the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) for noncoal project areas. The sampling design and methods used for the vegetation study followed Rule 1-V (revegetation performance standards): Noncoal Rules, Chapter 3 (WDEQ/LQD, amended April 25, 2006), WDEQ/LQD Guideline Number 2 (WDEQ/LQD 1997), and WDEQ/LQD Draft Guideline 2 Rewrite (WDEQ/LQD 2004).

The objectives of the vegetation study are: 1) to establish a detailed inventory of the premine vegetation characteristics within and adjacent to the project area; and 2) to provide baseline vegetation information for evaluating future reclamation success within the project area.

The information presented herein includes a description of the vegetation types and their distribution, species diversity, and composition; percent vegetative and percent total ground cover; and existing disturbances within the project area. Baseline data will be used to assess reclamation success during bond release.

The extended reference area concept was employed for this study.

D8.2.0 LOCATION

The Nichols Ranch ISR Project area is located in Campbell and Johnson Counties, Wyoming, and encompasses two production units--the Hank Unit and the Nichols Ranch Unit. The total project area encompasses approximately 3,370.53 acres in portions of Sections 7, 8, 17, 18, and 20, T43N, R76W (refer to Exhibit D8-1), and Sections 30 and 31, T44N, R75W, and Sections 5, 6, 7 and 8, T43N, R75W (refer to Exhibit D8-2). Access is by way of the Van Buggenum Road west from Wyoming Highway 50. The project area is within the 10- to 14-inch Northern Plains (10-14NP) zone of northeastern Wyoming (Natural Resources Conservation Service [NRCS] 1988). Topographic relief ranges from 5,055 to 5,209 ft above mean sea level in the Hank Unit and from 4,670 to 4,900 ft above mean sea level in the Nichols Ranch Unit. Annual precipitation varies from 10 to 14 inches, with approximately 35-41% falling during the normal growing season (NRCS 1988). Growth of native cool-season plants begins about April 1 and continues to about July 1. Growth of native warm-season plants begins about May 15 and continues to about August 15. According to Wyoming Gap data, two primary vegetation types occur in the project area--sagebrush shrubland and mixed grassland (Wyoming Gap Analysis 2000).

There are no perennial streams, ponds, or lakes in the project area. Cottonwood Creek, an ephemeral stream, is the main drainage in the Nichols Ranch Main Unit. Several springs with adjacent wetlands are located in the Cottonwood Creek drainage in the southeast corner of the Nichols Ranch Main Unit. Within the project area, Cottonwood Creek has been physically altered by local ranches, and a system of irrigation ditches has been constructed to supply water to the area for hay production; therefore, there is no defined bed/bank with a typical pool-riffle riverine system in the project area. Two ephemeral streams--Dry Willow Creek and Willow Creek--are the main drainages of the Hank Unit. Current land use in the project area is primarily livestock grazing, wildlife habitat, and coalbed methane and natural gas development.

D8.3.0 METHODS

Procedures used in conducting the vegetation studies followed Rule 1-V (revegetation performance standards): Noncoal Rules, Chapter 3 (WDEQ/LQD, amended April 25, 2006), WDEQ/LQD Guideline Number 2 (WDEQ/LQD 1997), and WDEQ/LQD Draft Guideline 2 Rewrite (WDEQ/LQD 2004).

Sampling included the collection of percent vegetative and total ground cover data. A plant species list was compiled (Addendum D8B), and searches were conducted within the project area for species of special concern, noxious weeds, and selenium indicator species. Premine sampling methods followed the requirements for using an extended reference area for postmine bond release studies.

D8.3.1 MAPPING

Vegetation communities, including wetlands (in accordance with U.S. Army Corps of Engineers1987; Wetland Training Institute, Inc. 1995; refer to Appendix D10), were delineated in the field by TRC using U.S. Geological Survey (USGS) quadrangles and aerial photograph imagery and are presented on a 1 inch = 500 ft enlargement of the USGS 7.5' quadrangles (Dryfork Ranch, Rolling Pin Ranch, North Butte, and Fort Reno SE). Vegetation communities were based on dominant plant species (see Exhibits D8-1 and D8-2). Vegetation mapping included the project area and a 0.5-mi wide buffer adjacent to the project area. Photographs were taken of each vegetation community and are presented in Addendum D8A.

D8.3.2 SAMPLE SITE LOCATION

Sample sites were randomly selected using the ArcView 9.0 Hawth's tool in the geographic information system (GIS) for each vegetation community. The sample sites were downloaded into a handheld Trimble GeoExplorer global position system (GPS) unit and located in the field. Transect direction was determined by tossing a 12-inch spike in the air at each sample site. The

pointed end of the spike determined the transect direction. The locations of the randomly selected sample sites and the direction of each transect are presented on Exhibits D8-1 and D8-2.

D8.3.3 COVER

Vegetative cover by species for graminoides, grass-like species, forbs, subshrubs, shrubs, succulents, and other species (i.e., lichen) was determined along each of the 50-m long point-intercept transects within the sagebrush shrubland, mixed grassland, juniper outcrop, bottomland, and greasewood shrubland communities. Sampling was conducted July 18-25, 2006. Under the extended reference area concept, each vegetation community to be affected was sampled as one unit, with affected and unaffected areas combined according to the baseline sampling methodology outlined in WDEQ/LQD (1997, 2004, 2006). The point-intercept method was used to record primary and secondary hits (occurrences) of the current year's vegetative growth at 50 points spaced at 1-m intervals. Litter (previous years' growth or dead material), rock, and bare ground were also recorded along each transect. Sampling intensity and maximum sample size for each vegetation community was based on WDEQ/LQD Regulations (2004: Table D8-1). In accordance with the approved vegetation sampling plan, rock outcrop, wetlands, and disturbed lands were not sampled for cover. Each transect was analyzed as one sample (n), with primary hits used for total cover estimates (absolute) and for relative cover by species. Formulas used to calculate cover (absolute and relative) followed those presented in the WDEQ/LQD (1997) Guideline No. 2 and as revised in WDEQ/LQD Regulations (2004).

The following parameters were determined for each vegetation community:

- percent total vegetation cover (i.e., sum of all species),
- percent total ground cover (i.e., vegetation + litter + rock), and
- percent bare ground.

D8.3.4 STATISTICAL EVALUATIONS

Sample adequacy (i.e., Nmin) for vegetation cover was determined based on those tests outlined in WDEQ/LQD Guideline No. 2. The sample adequacy formula provided below was used to

determine the minimum number of sample points needed in the sage brush shrubland, mixed grassland, juniper outcrop, and bottomland. The number of sample points for the greasewood shrubland (15) was based on WDEQ/LQD (2004) Draft Guidelines and consultation with Stacy Page, WDEQ/LQD, in July 2006. A minimum of 20 cover transects were sampled prior to determining sample adequacy.

Sample Adequacy Formula:

$$Nmin = \frac{2(sz)^2}{(dx)^2}$$

where:

Nmin	=	required size of the sample population
s	=	sample standard deviation
z	=	the z statistic (1.28)
d	=	the acceptable amount of inherent variability between the sample mean and the true population (0.1)
x	=	sample mean for cover

D8.3.5 SPECIES LIST

A plant species list was compiled during the vegetation mapping and sampling tasks. Plants are listed by scientific and common names and life form (i.e., annual grasses, perennial grasses, other grass-like species, annual and perennial forbs, succulents, subshrubs, full shrubs, and trees) for the project area. Plant species were identified and named using taxonomic keys including Dorn (1988), Beetle and Johnson (1996), Fertig et al. (1994), Hallsten et al. (1987), Stubbendieck et al. (1997), and Whitson et al. (1991). Plant species that could not be identified in the field were collected and taken to the Rocky Mountain Herbarium, University of Wyoming, for identification.

D8.3.6 THREATENED AND ENDANGERED SPECIES, SPECIES OF CONCERN, NOXIOUS WEEDS, AND SELENIUM INDICATOR SPECIES

The vegetation study included a survey for plant species that are federally threatened and endangered (T&E), that are noxious weeds, and that are selenium indicators. The U.S. Fish and Wildlife Service was consulted concerning federal T&E species. In addition, a request was submitted to the Wyoming Natural Diversity Database, Laramie, Wyoming, for recorded occurrence of T&E species in and in the vicinity of the project area.

A list of prohibited, restricted, and declared weeds was obtained from the Wyoming Weed and Pest Council website at www.wyoweed.org. A list of selenium indicator plant species was obtained from WDEQ/LQD Guideline No. 2.

D8.4.0 RESULTS

Field mapping and sampling were conducted early summer 2006 and the results are included in this section. The types and acreages of each vegetation community/habitat type are presented in Table D8-1.

Construction of the two project production plants will occur in two vegetation communities--sagebrush shrubland and mixed grassland (see Exhibits D8-1 and D8-2). The other vegetation communities--juniper outcrop, bottomland, disturbed lands, and greasewood shrubland--and the one habitat type--rock outcrop--found in the project area may be disturbed by wells and pipelines and additional access roads. This assumes that the injection, recovery, and monitoring wells

Table D8-1 Vegetation/Habitat Types, Number of Acres, and Sampling Intensity, Nichols Ranch ISR Project, 2006.

Vegetation/ Habitat Type	Premine No. of Acres	Percent of Project Area	Estimated Affected Acres	Minimum Sample Size[1]	Adequate Sample Size (Nmin)[2] for Vegetative Cover
Sagebrush shrubland	1,905.4	56.8	7	20	6.3
Mixed grassland	1,061.7	31.4	5	20	10.2
Juniper outcrop	148.3	4.4		20	28.2
Bottomland	125.1	3.7		20	16.5
Greasewood shrubland	64.4	1.9		15	12.2
Wetland	1.1	<0.1		Not sampled	--
Rock outcrop	17.5	0.5		Not sampled	--
Disturbed lands[3]	42.3	1.2		Not sampled	--
Total	3,370.53	100	12[4]		

1 Based on WDEQ/LQD (2004) and on approved sampling plan for the project submitted WDEQ/LQD prior to sampling.
2 See Table D8-7.
3 Includes 8.3 acres of previously disturbed lands as evident by annual grasses and weeds and 8.8 mi (32.0 acres) of roads (30-ft wide disturbance).
4 Estimated disturbance from the two production plants. Disturbance from wells, pipelines, and additional access roads is unknown.

would be located over the uranium ore body and that the processing plants would be located as shown on Exhibits D8-1 and D8-2.

One additional vegetation community--wetlands--also occurs in the project area. Since this wetland community is located adjacent to a water of the U.S., it was determined to be jurisdictional and under the regulation of the U.S. Army Corp of Engineers. The wetland community was not sampled for cover; however, the boundary was delineated following the *Wetlands Delineation Manual* (U.S. Army Corps of Engineers 1987) so it could be avoided by project activities. A detailed description of the wetland community is presented in Appendix D10.

Photographs of each vegetation community within the project area are provided in Addendum D8A, the plant species list is provided in Addendum D-B, cover data for each transect are presented in Addendum D8C, and Addendum D8D presents correspondence with the USFWS and WNDD.

D8.4.1 MAPPING AND DESCRIPTION OF VEGETATION COMMUNITIES

Seven vegetation communities--sagebrush shrubland, mixed grassland, juniper outcrop, bottomland, greasewood shrubland, wetland, and disturbed lands--and one habitat type--rock outcrop--were identified within the project area (Exhibits D8-1 and D8-2). Approximately 40.3 acres (1.2%) of the 3,370.53-acre project area have been disturbed by coalbed methane and oil and gas development and existing access roads. The two production plants are expected to disturb a total of 12 acres primarily in the sagebrush shrubland and mixed grassland vegetation communities. The injection, recovery, and monitoring wells are expected to disturb unknown amounts of juniper outcrop, bottomland, greasewood shrubland, and rock outcrop areas. Wetlands will be avoided and will not be disturbed.

Tables D8-2 to D8-6 summarize the mean, absolute and relative cover by species, and life form for each vegetation community sampled. Tables D8C-1 to D8C-5 in Addendum D8C project

Table D8-2 Total Number of Hits, Mean, Percent Absolute Cover, and Percent Relative Vegetative Cover, Sagebrush Shrubland, Nichols Ranch ISR Project, 2006.

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Perennial Grass				
Aristida purpurea longiseta	2	0.10	0.2	0.4
Bouteloua gracilis	11	0.55	1.1	2.2
Calamovilfa longifolia	2	0.10	0.2	0.4
Elymus spicatus	9	0.45	0.9	1.8
Elymus smithii	6	0.30	0.6	1.2
Koeleria macrantha	14	0.70	1.4	2.8
Poa secunda	49	2.45	4.9	9.7
Oryzopsis hymenoides	2	0.10	0.2	0.4
Stipa comata	54	2.70	5.4	10.7
Stipa viridula	2	0.10	0.2	0.4
Subtotal	151	7.55	15.1	30.0
Annual Grasses				
Festuca octoflora	14	0.70	1.4	2.8
Bromus japanicus	24	1.20	2.4	4.8
Bromus tectorum	34	1.70	3.4	6.7
Subtotal	72	3.60	7.2	14.3
Other Grasslike Species				
Carex filifolia	65	3.25	6.5	12.9
Subtotal	65	3.25	6.5	12.9
Perennial Forb				
Lygodesmia juncea	2	0.10	0.2	0.4
Psoralea tenuiflora	1	0.05	0.1	0.2
Subtotal	3	0.15	0.3	0.6
Annual Forbs				
Alyssum parvifolia	21	1.05	2.1	4.2
Lappula redowski	1	0.05	0.1	0.2
Plantago patagonia	13	0.65	1.3	2.6
Subtotal	35	1.75	3.5	7.0

Table D8-2 (Continued)

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Subshrub				
Artemisia frigida	1	0.05	0.1	0.2
Leptodactylon pungens	2	0.10	0.2	0.4
Gutierrezia sarothrae	2	0.10	0.2	0.4
Subtotal	5	0.25	0.5	1.0
Succulent				
Opuntia polyacantha	6	0.30	0.6	1.2
Subtotal	6	0.30	0.6	1.2
Shrub				
Artemisia cana	1	0.05	0.1	0.2
Artemisia tridentata wyomingensis	164	8.20	16.4	32.5
Cercocarpus montanus	1	0.05	0.1	0.2
Krascheninnikovia lanata	2	0.10	0.2	0.4
Subtotal	168	8.40	16.8	33.3
Total No. of Vegetative Hits	505	25.25	50.5	100.3[1]
% Vegetative Cover		**50.50**		
Litter	244	12.20	24.4	48.3
Rock	5	2.50	0.5	1.0
Subtotal	249	14.70	24.9	49.3
Total No. of Ground Cover Hits	754			
% Total Ground Cover		**75.40**		
Bare Ground No. of Hits	246	12.30		
% Bare Ground		**24.60**		

[1] May not total to 100 due to rounding.

Table D8-3 Total Number of Hits, Mean, Percent Absolute Cover, and Percent Relative Vegetative Cover, Mixed Grassland, Nichols Ranch ISR Project, 2006.

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Perennial Grass				
Agropyron cristatum	1	0.05	0.1	0.2
Aristida purpurea longiseta	1	0.05	0.1	0.2
Bouteloua gracilis	26	1.30	2.6	5.7
Calamovilfa longifolia	2	0.10	0.2	0.4
Elymus spicatus	9	0.45	0.9	2.0
Elymus smithii	15	0.75	1.5	3.3
Koeleria macrantha	13	0.65	1.3	2.8
Poa secunda	38	1.90	3.8	8.3
Oryzopsis hymenoides	2	0.10	0.2	0.4
Stipa comata	73	3.65	7.3	16.0
Stipa viridula	3	0.15	0.3	0.7
Subtotal	183	9.15	18.3	40.3
Annual Grasses				
Festuca octoflora	5	0.25	0.5	1.1
Bromus japanicus	8	0.40	0.8	1.8
Bromus tectorum	22	1.10	2.2	4.8
Subtotal	35	1.75	3.5	7.7
Other Grasslike Species				
Carex filifolia	162	8.10	16.2	35.4
Subtotal	162	8.10	16.2	35.7
Perennial Forb				
Eriogonum spp.	1	0.05	0.1	0.2
Heterotheca villosa	3	0.15	0.3	0.7
Phlox hoodii	1	0.05	0.1	0.2
Psoralea tenuiflora	4	0.20	0.4	0.9
Sphaeralcea coccinea	4	0.20	0.4	0.9
Unknown forb	1	0.05	0.1	0.2
Yucca glauca	1	0.05	0.1	0.2
Subtotal	15	0.75	1.5	3.3

Table D8-3 (Continued)

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Annual Forbs				
Alyssum parvifolia	7	0.35	0.7	1.5
Plantago patagonia	13	0.65	1.3	2.9
Unknown annual forb	1	0.05	0.1	0.2
Subtotal	21	1.05	2.1	4.6
Subshrub				
Artemisia frigida	2	0.10	0.2	0.4
Leptodactylon pungens	5	0.25	0.5	1.1
Gutierrezia sarothrae	2	0.10	0.2	0.4
Subtotal	9	0.45	0.9	1.9
Succulent				
Opuntia polyacantha	8	0.40	0.8	1.8
Subtotal	8	0.40	0.8	1.8
Shrub				
Artemisia cana	1	0.05	0.1	0.2
Artemisia tridentata wyomingensis	18	0.90	1.8	4.0
Chrysothamnus viscidiflorus	1	0.05	0.1	0.2
Krascheninnikovia lanata	1	0.05	0.1	0.2
Subtotal	21	1.05	2.1	4.6
Total No. of Vegetative Hits	454	22.7	45.4	99.9[1]
% Vegetative Cover		45.40		
Litter	247	12.35	24.7	54.4
Rock	18	0.90	1.8	4.0
Subtotal	265	13.25	26.5	58.4
Total No. of Ground Cover Hits	719			
% Total Ground Cover		71.90		
Bare Ground No. of Hits	281	14.10		
% Bare Ground		28.10		

[1] May not total to 100 due to rounding.

Table D8-4 Total Number of Hits, Mean, Percent Absolute Cover, and Percent Relative Vegetative Cover, Juniper Outcrop, Nichols Ranch ISR Project, 2006.

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Perennial Grass				
Bouteloua gracilis	8	0.40	0.8	1.9
Calamovilfa longifolia	2	0.10	0.2	0.5
Elymus cinereus	12	0.60	1.2	2.9
Elymus spicatus	27	1.35	2.7	6.4
Koeleria macrantha	12	0.60	1.2	2.9
Poa secunda	4	0.20	0.4	1.0
Poa spp.	1	0.05	0.1	0.2
Oryzopsis hymenoides	8	0.40	0.8	1.9
Stipa comata	53	2.65	5.3	12.6
Unknown perennial grass	1	0.05	0.1	0.2
Subtotal	128	6.4	12.8	30.2
Annual Grasses				
Bromus japanicus	1	0.05	0.1	0.2
Bromus tectorum	33	1.65	3.3	7.8
Subtotal	34	1.70	3.4	8.0
Other Grasslike Species				
Carex filifolia	26	1.30	2.6	6.2
Subtotal	26	1.30	2.6	6.2
Perennial Forb				
Achillea millefolium	1	0.05	0.1	0.2
Arenaria hookeri	2	0.10	0.2	0.5
Astragalus bisulcatus	2	0.10	0.2	0.5
Cirsium arvense	2	0.10	0.2	0.5
Chaenactis douglasii	2	0.10	0.2	0.5
Heterotheca villosa	1	0.05	0.1	0.2
Lupinus spp.	1	0.05	0.1	0.2
Phlox hoodsii	1	0.05	0.1	0.2
Psoralea tenuiflora	9	0.45	0.9	2.1
Sphaeralcea coccinea	1	0.05	0.1	0.2
Unknown forb	1	0.05	0.1	0.2
Unknown aster	2	0.10	0.2	0.5
Subtotal	25	1.25	2.5	5.8

Table D8-4 (Continued)

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Annual Forbs				
Alyssum parvifolia	12	0.60	1.2	2.9
Lappula redowski	1	0.05	0.1	0.2
Subtotal	13	0.65	1.3	3.0
Subshrub				
Artemisia frigida	1	0.05	0.1	0.2
Leptodactylon pungens	2	0.10	0.2	0.5
Gutierrezia sarothrae	11	0.55	1.1	2.6
Subtotal	14	0.70	1.4	3.3
Succulent				
Opuntia polyacantha	2	0.10	0.2	0.5
Subtotal	2	0.10	0.2	0.5
Shrub				
Artemisia tridentata wyomingensis	100	5.00	10.0	23.8
Chrysothamnus nauseosus	1	0.05	0.1	0.2
Chrysothamnus viscidiflorus	1	0.05	0.1	0.2
Krascheninnikovia lanata	4	0.20	0.4	1.0
Rhus trilobata	1	0.05	0.1	0.2
Symphoricarpos occidentialis	3	0.15	0.3	0.7
Subtotal	110	5.50	11.0	25.9
Trees				
Juniperus scopulorum	67	3.35	6.7	15.9
Pinus flexilis	3	0.15	0.3	0.7
Subtotal	70	3.50	7.0	16.6
Total No. of Vegetative Hits	422	21.10	42.2	99.5[1]
% Vegetative Cover		42.20		
Litter	131	6.55	13.1	31.1
Rock	147	7.35	14.7	34.9
Subtotal	278	13.90	27.8	65.8
Total No. of Ground Cover Hits	700			
% Total Ground Cover		70.00		
Bare Ground No. of Hits	300	15.00		
% Bare Ground		30.00		

[1] May not total to 100 due to rounding.

Table D8-5 Total Number of Hits, Mean, Percent Absolute Cover, and Percent Relative Vegetative Cover, Bottomland, Nichols Ranch ISR Project, 2006.

Vegetation Type/Species	Total No. of Primary Hits	Mean	Absolute Cover	Percent Relative Vegetation Cover
Perennial Grass				
Bromus inermis	38	1.90	3.8	7.0
Distichlis stricta	14	0.70	1.4	2.6
Elymus intermedium	8	0.40	0.8	1.5
Elymus smithii	217	10.85	21.7	40.2
Hordeum jubatum	25	1.25	2.5	4.6
Koeleria macrantha	2	0.10	0.2	0.4
Poa secunda	11	0.55	1.1	2.0
Poa spp.	6	0.30	0.6	1.1
Sporobolus airoides	1	0.05	0.1	0.2
Unknown perennial grass	3	0.15	0.3	0.6
Subtotal	325	16.25	32.2	60.2
Annual Grasses				
Bromus tectorum	86	4.30	8.6	15.9
Subtotal	86	4.30	8.6	15.9
Other Grasslike Species				
Carex filifolia	1	0.05	0.1	0.2
Carex praegracilis	4	0.20	0.4	0.7
Equisetum spp.	6	0.30	0.6	1.1
Juncus balticus	1	0.05	0.1	0.2
Subtotal	12	0.60	1.2	2.2
Perennial Forb				
Achillea millefolium	2	0.10	0.2	0.4
Asclepias specious	1	0.05	0.1	0.2
Cirsium arvense	10	0.50	1.0	1.9
Grindellia squarosa	2	0.10	0.2	0.4
Melilotus officinalis	1	0.05	0.1	0.2
Unknown forb	1	0.05	0.1	0.2
Unknown aster	6	0.30	0.6	1.1
Subtotal	23	1.15	2.3	4.4

Table D8-5 (Continued)

Vegetation Type/Species	Total No. of Primary Hits	Mean	Absolute Cover	Percent Relative Vegetation Cover
Annual Forbs				
Alyssum parvifolia	3	0.15	0.3	0.6
Descurainia sophia	8	0.40	0.8	1.5
Kochia scoparia	74	3.70	7.4	13.7
Madia glomerata	3	0.15	0.3	0.6
Plantago patagonia	1	0.05	0.1	0.2
Unknown annual forb	1	0.05	0.1	0.2
Subtotal	90	4.50	9.0	16.8
Subshrub				
Artemisia frigida	3	0.15	0.3	0.6
Subtotal	3	0.15	0.3	0.6
Shrub				
Artemisia cana	1	0.05	0.1	0.2
Krascheninnikovia lanata	0	0.00	0.0	0.0
Subtotal	1	0.05	0.1	0.2
Total No. of Vegetative Hits	540	27.00	54.0	100.3[1]
% Vegetative Cover		54.00		
Litter	374	18.70	37.4	
Rock	0		0.0	
Subtotal	374	18.70	37.4	
Total No. of Ground Cover Hits	914			
% Total Ground Cover		91.40		
Bare Ground No. of Hits	86	4.30		
% Bare Ground		8.60		

[1] May not total to 100 due to rounding.

Table D8-6 Total Number of Hits, Mean, Percent Absolute Cover, and Percent Relative Vegetative Cover, Greasewood Shrubland, Nichols Ranch ISR Project, 2006.

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Perennial Grass				
Bouteloua gracilis	5	0.33	0.7	1.3
Distichlis stricta	1	0.07	0.1	0.2
Elymus spicatus	4	0.27	0.5	0.9
Elymus smithii	30	2.00	4.0	7.5
Koeleria macrantha	3	0.20	0.4	0.8
Poa secunda	22	1.47	2.9	5.5
Oryzopsis hymenoides	8	0.53	1.1	2.1
Sporobolus airoides	2	0.13	0.3	0.6
Stipa comata	18	1.20	2.4	4.5
Subtotal	93	6.2	12.4	23.4
Annual Grasses				
Bromus japanicus	3	0.20	0.4	0.8
Bromus tectorum	123	8.20	16.4	30.9
Subtotal	126	8.4	16.8	31.7
Other grasslike species				
Carex filifolia	30	2.00	4.0	7.5
Subtotal	30	2.00	4	7.5
Perennial Forb				
Phlox hoodii	2	0.13	0.3	0.6
Sphaeralcea coccinea	1	0.07	0.1	0.2
Unknown forb	3	0.20	0.4	0.8
Subtotal	6	0.40	0.8	1.6
Annual Forbs				
Alyssum parvifolia	26	1.73	3.5	6.6
Kochia scoparia	4	0.27	0.5	0.9
Plantago patagonia	13	0.87	1.7	3.2
Subtotal	43	2.87	5.7	10.7

Table D8-6 (Continued)

Vegetation Type/Species	Total No. of Primary Hits	Mean	Percent Absolute Cover	Percent Relative Vegetation Cover
Subshrub				
Artemisia pedatifida	14	0.93	1.9	3.6
Subtotal	14	0.93	1.9	3.6
Succulent				
Opuntia polyacantha	28	1.87	3.7	7.0
Subtotal	28	1.87	3.7	7.0
Shrub				
Artemisia cana	1	0.07	0.1	0.2
Artemisia tridentata wyomingensis	19	1.27	2.5	4.7
Atriplex gardneri	1	0.07	0.1	0.2
Chrysothamnus viscidiflorus	2	0.13	0.3	0.6
Sarcobatus vermiculatus	36	2.40	4.8	9.0
Subtotal	59	3.93	7.8	14.7
Total No. of Vegetative Hits	399	26.60	53.1	100.2[1]
% Vegetative Cover		53.20		
Litter	166	11.07	22.1	41.6
Rock	0	0.00	0.0	0.0
Subtotal	166	11.10	22.1	41.6
Total No. of Ground Cover Hits	565			
% Total Ground Cover		75.33		
Bare Ground No. of Hits	185	12.33		
% Bare Ground		24.67		

[1] May not total to 100 due to rounding.

data by transect for each vegetation community sampled. The locations of trees are provided on Exhibits D8-1 and D8-2.

D8.4.1.1 Sagebrush Shrubland Community

The sagebrush shrubland community occurs on approximately 1,905.4 acres (56.8%) within the project area. This vegetation community generally occurs on loamy moderately deep soils on gently sloping uplands, upland ridges, shoulders, and hillslopes. Vegetation is dominated by Wyoming sagebrush (*Artemisia tridentata wyomingensis*) and perennial grasses--needle-and-thread (*Stipa comata*), Sandberg blue grass (*Poa secunda*), prairie junegrass (*Koeleria macrantha*), and blue grama (*Bouteloua gracilis*)--and annual grasses--six-weeks fescue (*Festuca octoflora*) and Japanese and downy brome (*Bromus japanicus* and *B. tectorum*). A grasslike species--threadleaf sedge (*Carex filifolia*)--is a dominate species in this community. Annual forbs such as alyssum (*Alyssum parvifolia*) and wooly plantain (*Plantago patagonia*) are more common in this community than any perennial forb. Several scattered cottonwood and juniper trees also occur in this community and are generally found growing along the drainages (see Exhibits D8-1 and D8-2).

D8.4.1.2 Mixed Grassland Community

The mixed grassland community occurs on approximately 1,061.7 acres (31.4%) within the project area. This vegetation community generally occurs on shallow sandy soils on upland ridges and gently sloping shoulders and hillslopes, as well as on nearly level uplands. Vegetation is mainly perennial grasses such as needle-and-thread, Sandberg bluegrass, blue grama, western wheatgrass (*Elymus smithii*), and bluebunch wheatgrass (*Elymus spicatus*) and grasslike species such as threadleaf sedge. Scurfpea (*Psoralea tenuiflora*), yucca (*Yucca glauca*), and globemallow (*Sphaeralcea coccinea*) are the common perennial forbs, and wooly plantain is the dominate annual forb in this community. Wyoming sagebrush and silver sagebrush (*Artemisia cana*) occur in scattered low-density stands throughout this community. Subshrubs such as fringed sage (*Artemisia fridiga*) and broom snakeweed (*Gutierrezia sarothrae*) occur throughout this community. No trees occur in this plant community.

D8.4.1.3 Juniper Outcrop Community

The juniper outcrop community occurs on approximately 148.3 acres (4.4%) within the project area. This community occurs on the side slope and top of North Middle Pumpkin Butte in the Hank Unit. Soils are generally shallow, with areas of deeper soils in swales. Areas of exposed bedrock, boulders, and gravel occur throughout this community. Rocky Mountain juniper (*Juniperus scopulorum*) and Wyoming sagebrush are the most visible species of this community and are scattered throughout the community. Perennial grasses include needle-and-thread, bluebunch wheatgrass, prairie junegrass, and Indian ricegrass (*Oryzopsis hymenoides*). Basin wildrye (*Elymus cinereus*) is common in the swales within this community. This community supports a wide diversity of perennial forb and shrub species (refer to Table D8-4) due to the numerous microhabitats created by the various soil depths and moisture and rock outcrop areas. Skunkbush (*Rhus trilobata*), snowberry (*Symphoricarpos occidentalis*), Rocky Mountain juniper, and limber pine (*Pinus flexilis*) occur only in this vegetation community.

D8.4.1.4 Bottomland Community

The bottomland community occurs on approximately 125.1 acres (3.7%) within the Nichols Ranch Unit of the project area adjacent Cottonwood Creek. Currently, this community is used for livestock grazing, but historically this community has been managed for hay production. In the project area, Cottonwood Creek has no defined channel. The drainage in the area has been modified by a system of irrigation canals that meander throughout this vegetation community. The vegetation is composed of grasses and forbs, with scattered mature or dead plains cottonwood (*Populus deltoides*) trees ranging from 20 to 60 ft tall. A significant portion of the bottomland community includes weedy annuals such as kochia (*Kochia scorparia*), flixweed tanseymustard (*Descurainia sophia*), and Canada thistle (*Cirsium arvense*). Perennial grasses include western wheatgrass, smooth brome (*Bromus inermis*), inland saltgrass (*Distichlis stricta*), foxtail barley (*Hordeum jubatum*), Sandberg bluegrass, and several hybrid wheatgrass, fescue, and bluegrass species. Portions of the bottomland community in and adjacent irrigation canals generally support a higher percentage of sedges such as Baltic rush (*Juncus balticus*),

clustered field sedge (*Carex praegracilis*), and horsetails (*Equisetum* spp.). Scattered cottonwood trees occur in this community (see Exhibit D8-2).

D8.4.1.5 Greasewood Shrubland Community

The greasewood shrubland community occurs on approximately 64.4 acres (1.9%) within the Nichols Ranch Unit of the project area. Of the vegetation types delineated in the project area, greasewood (*Sarcobatus vermiculatus*), Gardner's saltbush (*Atriplex gardnerii*), and birdfoot sage (*Artemisia pedatifida*) occur exclusively in the greasewood shrubland community. Perennial grasses include Sandberg bluegrass, western wheatgrass, alkali sacaton (*Sporobolus airoides*), and needle-and-thread. Downy brome and prickly pear cactus (*Opuntia polyacantha*), both invasive species, are prevalent in this community.

D8.4.1.6 Wetland Community

The wetland community occurs on approximately 1.1 acres (<0.1%) within the Nichols Ranch Unit of the project area. A detailed description of this community is presented in Appendix D10. The wetland community was not sampled for cover.

D8.4.1.7 Rock Outcrop Habitat

The rock outcrop habitat occurs on approximately 17.5 acres (0.5%) within the project area. This habitat type is scattered throughout the project area as small inclusions generally occurring on the sides of exposed ridgetops, is composed of rocks, and is void of vegetation. Rock outcrop habitat was not sampled for cover.

D8.4.1.8 Disturbed Lands

Approximately 42.3 acres (1.2%) of the project area have been disturbed and reclaimed or are currently disturbed by coalbed methane development activities and existing access roads. This total includes 8.3 acres of previously disturbed lands, as evidenced by annual grasses and weeds

and 9.4 mi (32.0 acres) of roads (30-ft wide disturbance). Prior to disturbance, vegetation in these areas was probably similar to that of the vegetation communities immediately adjacent to the disturbed areas. Vegetated disturbed lands include monocultures of Japanese brome, downy brome, and crested wheatgrass (*Agropyron cristatum*). The disturbed lands community was not sampled for cover.

D8.4.2 COVER

Cover data were collected in accordance with the methods presented in Section D8.3.3, and the cover data results are summarized in Tables D8-2 to D8-6. Results of percent absolute and relative vegetative cover and total ground cover by life form and species for each transect are presented in Addendum D8C. Cover transect data was not collected from the wetland, rock outcrop, or disturbed land types.

D8.4.2.1 Sagebrush Shrubland Community

Absolute and relative cover by species and life form for the sagebrush shrubland is presented in Table D8-2. The mean vegetative cover in this community is 50.5%, and the mean total ground cover is 75.4%, with litter contributing an average 12.2% of the ground cover. Bare ground ranges from 12 to 32% and averaged 12.3%. The relative vegetative cover within this community averages approximately 30.0% perennial grasses, 14.3% annual grasses, 12.9% grasslike species (i.e., sedges), 0.6% perennial forbs, 7.0% annual forbs, 1.0% shrubs, 33.3% shrubs, and 1.2% succulents (refer to Table D8-2). Wyoming sagebrush is the dominant species of this vegetation community. Representative photographs of the sagebrush shrubland community are presented in Addendum D8A. The photograph locations are identified in Exhibits D8-1 and D8-2, and cover data for each transect are presented in Addendum D8C, Table D8C-1.

D8.4.2.2 Mixed Grassland Community

Absolute and relative cover by species and life form for the mixed grassland community is presented in Table D8-3. The mean vegetative cover in this community is 45.4%, and the mean total ground cover is 71.9%, with litter contributing an average 12.3% of the ground cover. Bare ground ranges from 6 to 42% and averaged 28.1%. Relative vegetative cover averages approximately 40.3% perennial grasses, 7.7% annual grasses, 35.7% grasslike species (i.e., sedges), 3.3% perennial forbs, 4.6% annual forbs, 1.9% subshrubs, 4.6% shrubs, and 1.8% succulents (refer to Table D8-3). Threadleaf sedge is the dominate species of this vegetation community. Representative photographs of the mixed grassland community are presented in Addendum D8A, and cover data for each transect are presented in Addendum D8C, Table D8C-2.

D8.4.2.3 Juniper Outcrop Community

Absolute and relative cover by species and life form for the juniper outcrop community is presented in Table D8-4. The mean vegetative cover in this community is 42.2%, and the mean total ground cover is 70.0%, with rock and litter contributing an average 13.9% of the ground cover. Bare ground ranged from 14 to 68% and averaged 30%. The relative vegetative cover averages approximately 30.2% perennial grasses, 8.0% annual grasses, 6.2% grasslike species (i.e., sedges), 5.8% perennial forbs, 3.0% annual forbs, 3.3% subshrubs, 25.9% shrubs, 16.6% trees, and 0.5% succulents (refer to Table D8-4). Rocky Mountain juniper, Wyoming sagebrush, and needle-and-thread are the dominant species. Representative photographs of the juniper outcrop community are presented in Addendum D8A, and cover data for each transect are presented in Addendum D8C, Table D8C-3.

D8.4.2.4 Bottomland Community

Absolute and relative cover by species and life form for the bottomland is presented in Table D8-5. The mean vegetative cover in this community is 54.0%, and the mean total ground cover is 91.4%, with litter contributing an average 18.7% of the ground cover. Bare ground

ranges from 0 to 22% and averages 8.6%. Relative vegetative cover within this community averages approximately 60.2% perennial grasses, 15.9% annual grasses, 2.2% grasslike species (i.e., sedges), 4.4% perennial forbs, 16.8% annual forbs, 0.6% subshrubs, and 0.2% shrubs (refer to Table D8-5). Although cottonwood trees are scattered throughout the bottomland community, none occurred in the cover transects. Representative photographs of the bottomland community are presented in Addendum D8A, and cover data for each transect are presented in Addendum D8C, Table D8C-4.

D8.4.2.5 Greasewood Shrubland Community

Absolute vegetative cover within the greasewood shrubland community averages 53.2% (refer to Table D8-6). Total ground cover averages 75.3%, with liter comprising 11.1% of the ground cover. Bare ground ranges from 0% to 58% and averages 24.7% (refer to Table D8-6). The relative vegetative cover within this community averages approximately 23.4% perennial grasses, 31.7% annual grasses, 7.5% grasslike species (i.e., sedges), 1.6% perennial forbs, 10.7% annual forbs, 3.6% subshrubs, 14.7% shrubs, and 7.0% succulents (refer to Table D8-6). Representative photographs of the greasewood shrubland community are presented in Addendum D8A, and cover data for each transect are presented in Addendem D8C, Table D8C-5.

D8.4.3 STATISTICAL EVALUATIONS

Sample adequacy for cover was achieved for four of the five sampled vegetation communities in accordance with the WDEQ/LQD Guideline No. 2. Sample adequacy was not achieved in the juniper outcrop community. Table D8-7 presents a summary of the statistical evaluation for the percent cover.

Table D8-7 Summary of Statistical Evaluation for Percent Cover for Five Vegetation Communities, Nichols Ranch ISR Project, 2006.

	Sagebrush Shrubland		Mixed Grassland		Juniper Outcrop		Bottomland		Greasewood Shrubland	
Transect	Vegetative Cover (%)	Total Cover (%)	Vegetative Cover (%)	Total Cover (%)	Vegetative Cover (%)	Total Cover (%)	Vegetative Cover (%)	Total Cover (%)	Vegetative Cover (%)	Total Cover (%)
1	56	80	24	64	40	82	82	100	40	48
2	46	72	56	80	44	78	62	90	66	88
3	52	84	36	68	50	84	46	96	46	100
4	38	70	56	94	48	74	64	98	48	84
5	48	78	42	66	58	76	44	82	46	80
6	44	68	56	72	22	44	62	94	54	60
7	62	76	52	78	20	32	42	92	34	42
8	52	72	44	64	50	62	56	98	48	72
9	44	72	46	72	60	86	68	94	54	74
10	54	80	44	62	68	82	56	98	68	86
11	66	84	44	74	34	72	42	96	62	86
12	44	68	50	76	36	76	48	88	50	84
13	58	76	44	68	40	60	42	82	58	86
14	46	68	44	74	52	80	58	92	70	78
15	46	70	46	70	42	84	40	84	54	62
16	54	88	58	84	40	74	74	98		
17	50	70	40	60	24	74	56	86		
18	46	80	38	58	40	56	38	78		
19	58	78	46	62	42	64	52	90		
20	46	74	42	92	34	60	50	92		
Mean	50.5	75.4	45.4	71.9	42.2	70.0	54.1	91.4	53.2	75.3
St Dev	7.02	5.95	8.03	10.07	12.38	14.22	12.13	6.33	10.28	15.98
d	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
z	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Nmin	6.3	2.0	10.2	6.4	28.2	15.8	16.5	1.4	12.2	14.7
n	20	20	20	20	20	20	20	20	15	15
CI	n/a	n/a	n/a	n/a	42.2±4.56	n/a	n/a	n/a	n/a	n/a

D8.4.4 SPECIES LIST

The list of plant species identified in the project area is presented in Addendum D8B. The number of species by life form and number of species greater than 2% relative cover for each vegetation community sampled is presented in Table D8-8.

D8.4.5 THREATENED AND ENDANGERED SPECIES, NOXIOUS WEEDS, AND SELENIUM INDICATOR SPECIES

No T&E plant species were observed, nor are any T&E plant species known to occur within the project area.

Based on the *Wyoming Weed and Pest Control Act* designated list (W.S.11-5-102 (a) (xi) and W.S.11-12-104), Canada thistle (*Cirsium arvense*) is the only prohibited and designated noxious weed species observed on the project area. Plants are concentrated around well pads and in the bottomland community where cattle tend to congregate. None of these areas are greater than 3 acres in size. No other declared weed species that are listed for Campbell or Johnson Counties (W.S.11-5-102 (a) (vii) and W.S.11-5-102(a)(viii)) occur in the project area.

One selenium indicator species, two-groove milkvetch (*Astragalus bisulcatus*), was observed within the project area. This species was observed primarily in small groups growing along the sides of several access roads. Species were verified at the Rocky Mountain Herbarium, University of Wyoming, Laramie.

Table D8-8 Species Composition and Species Diversity, Nichols Ranch ISR Project, 2006.

Lifeform	Sagebrush Shrubland		Mixed Grassland		Juniper Outcrop		Bottomland[1]		Greasewood Shrubland	
	Total No. Species	No. Species >2% Relative Cover	Total No. Species	No. Species >2% Relative Cover	Total No. Species	No. Species >2% Relative Cover	Total No. Species	No. Species >2% Relative Cover	Total No. Species	No. Species >2% Relative Cover
Perennial Grasses	10	4	11	6	10	4	10	5	9	4
Annual Grasses	3	3	3	1	2	1	1	1	2	1
Other Grass-like Species	1	1	1	1	1	1	4	0	1	1
Perennial Forbs	2	0	7	0	11	1	7	0	3	0
Annual Forbs	3	1	3	1	2	1	6	1	3	2
Subshrubs	3	0	3	0	3	1	1	0	1	1
Succulents	1	0	1	0	1	0	0	0	1	1
Shrubs	4	1	4	1	6	1	1	0	5	2
Trees	0	0	0	0	2	1	0	0	0	0

[1] Trees occur in bottomland; however, none of the randomly located sample point transects resulted in a hit.

D8.5.0 CONCLUSIONS

This vegetation study provides baseline data for a noncoal large or regular permit application, and was conducted in accordance with a study plan approved by WDEQ/LQD. This information will be used in the future by WDEQ/LQD to assess reclamation success. The methods used in this study comply with those outlined in WDEQ/LQD Guideline No. 2 for vegetation mapping, sampling, and statistical evaluation.

D8.6.0 LITERATURE CITED

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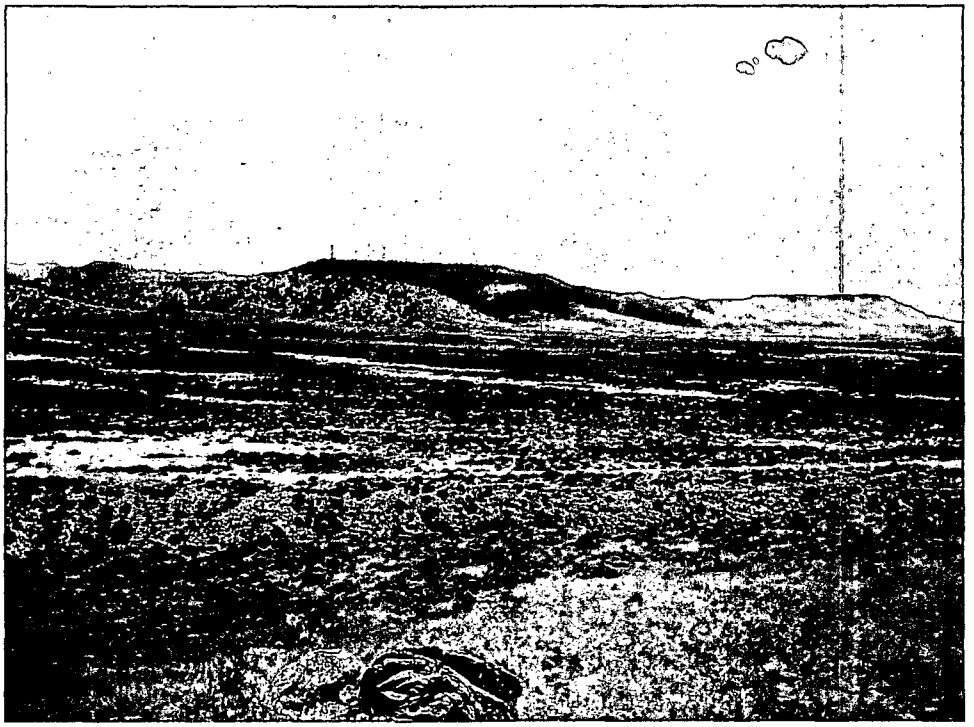
ADDENDUM D8A:

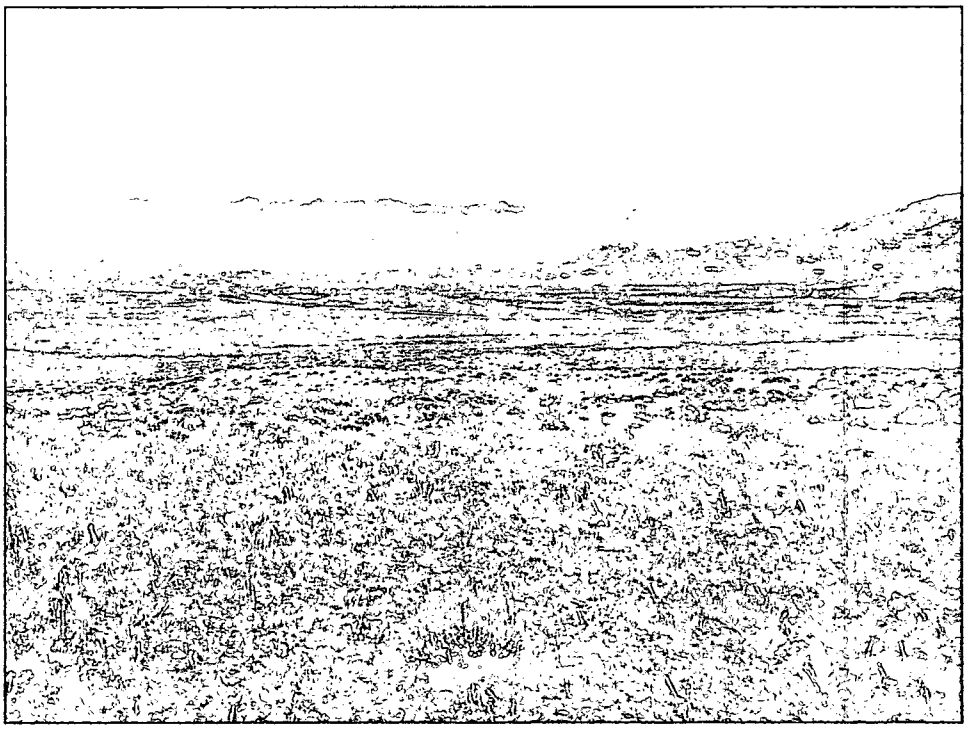
PHOTOGRAPHS OF VEGETATION COMMUNITIES

(Photograph locations are illustrated on Exhibits D8-1 and D8-2)

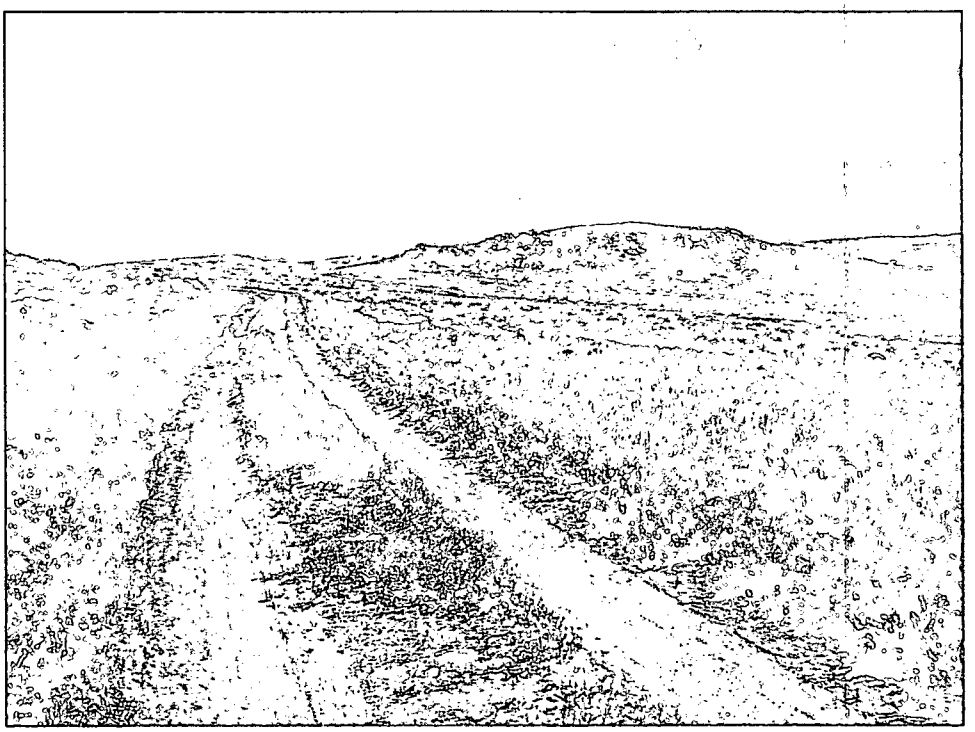


Photograph A.1 Sagebrush Shrubland, Hank Unit, June 2006.

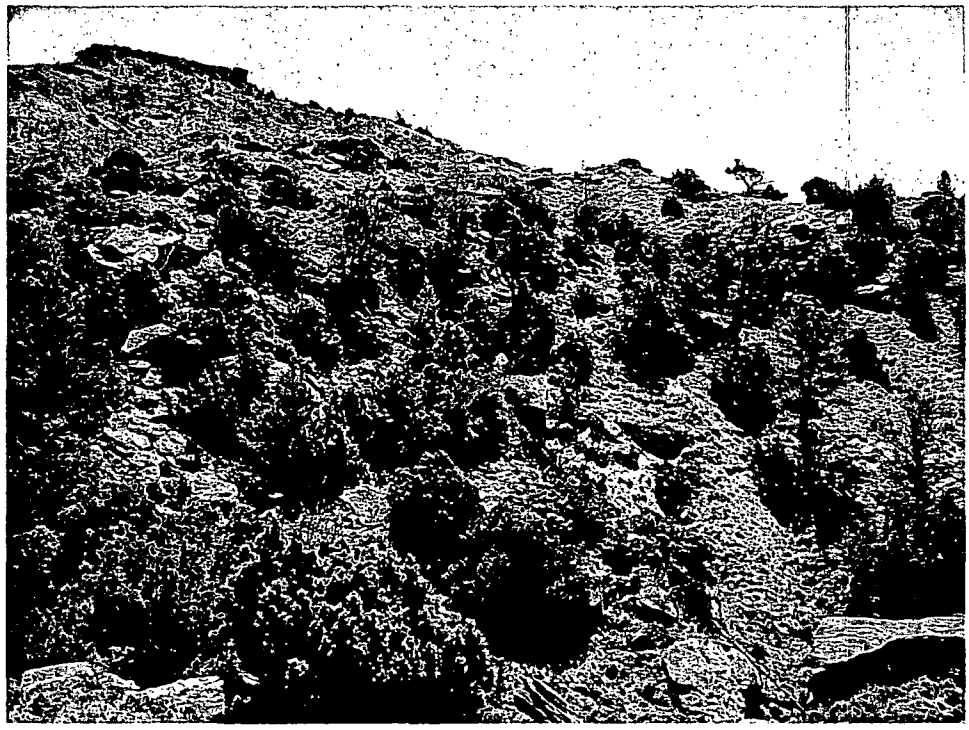
Photograph A.2 Sagebrush Shrubland, Nichols Ranch Unit, June 2006.



Photograph A.3 Mixed Grassland, Hank Unit, June 2006.

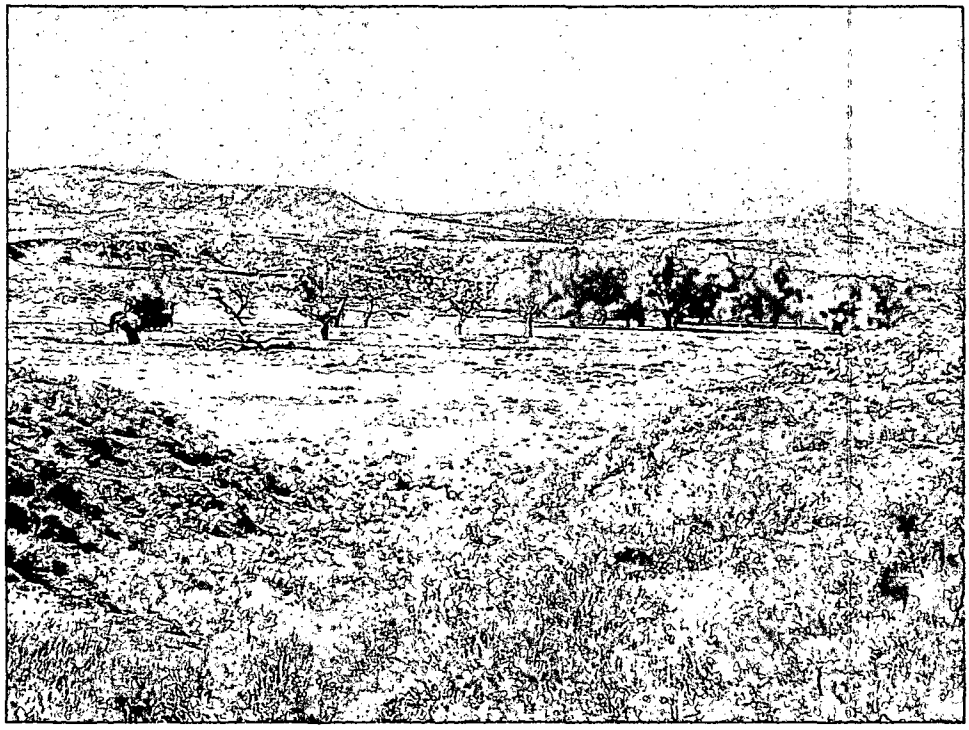


Photograph A.4 Mixed Grassland with Rock Outcrop in Background, Nichols Ranch Unit, June 2006.

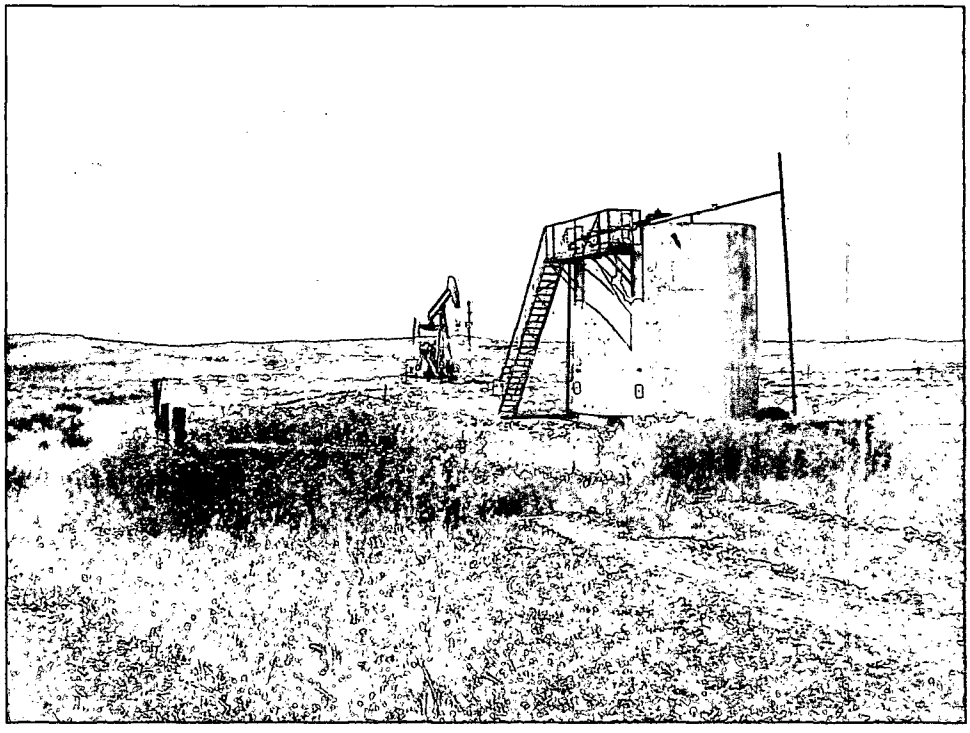


Photograph A.5 Juniper Outcrop, Hank Unit, June 2006.

Photograph A.6 Greasewood Shrubland, Nichols Ranch Unit, June 2006.



Photograph A.7 Bottomland, Nichols Ranch Unit, June 2006.



Photograph A.8 Disturbed Lands with Canada Thistle and Japanese Brome, Hank Unit, July 2006.

ADDENDUM D8B:

SPECIES LIST

Table D8B-1 Plant Species List and Occurrence, Nichols Ranch ISR Project, 2006.

Scientific Name	Common Name	Sagebrush Shrubland	Mixed Grassland	Juniper Outcrop	Bottomland	Greasewood Shrubland
Perennial Grass						
Agropyron cristatum	Crested wheatgrass		X			
Aristida purpurea longiseta	Three-awn	X	X			
Bromus inermis	Smooth brome				X	
Bouteloua gracilis	Blue grama	X	X	X		X
Calamovilfa longifolia	Prairie sandreed	X	X	X		
Distichlis stricta	Inland saltgrass				X	X
Elymus cinereus	Basin wild rye			X		
Elymus intermedium	Intermediate wheatgrass				X	
Elymus spicatus	Bluebunch wheatgrass	X	X	X		X
Elymus smithii	Western wheatgrass	X	X		X	X
Hordeum jubatum	Foxtail barley		X		X	
Koeleria macrantha	Prairie junegrass	X	X	X	X	X
Poa secunda	Sandberg bluegrass	X	X	X	X	X
Poa spp.	Bluegrass species			X	X	
Oryzopsis hymenoides	Indian ricegrass	X	X	X		X
Sporobolus airoides	Alkali sacaton				X	X
Stipa comata	Needle-and-thread	X	X	X		X
Stipa viridula	Green needlegrass	X	X			
Unknown perennial grass	--			X	X	
Annual Grasses						
Festuca octoflora	Six-week fescue	X	X			
Bromus japanicus	Japanese brome	X	X	X		X
Bromus tectorum	Cheatgrass (Downy brome)	X	X	X	X	X
Other Grasslike Species						
Carex filifolia	Threadleaf sedge	X	X	X	X	X
Carex praegracilis	Clustered field sedge				X	
Equisetum spp.	Scouring rush				X	
Juncus balticus	Baltic rush				X	
Perennial Forb						
Achillea millefolium	Yarrow			X	X	
Arenaria hookeri	Sandwort			X		
Asclepias specious	Milkweed			X	X	
Astragalus bisulcatus	Two-groove milkvetch	X	X	X	X	
Cirsium arvense	Canada thistle			X	X	
Chaenactis douglasii	Chaenactis			X		
Cryptantha flava	Cryptantha					
Eriogonium ovalifolium	Oval-leaf desert buckwheat	X				
Eriogonium spp.	Buckwheat		X			
Grindellia squarosa	Curlycup gumweed				X	
Haplopappus acaulis	Goldenweed		X	X		
Heterotheca villosa	Golden aster		X	X		

Table D8B-1 (Continued)

Scientific Name	Common Name	Sagebrush Shrubland	Mixed Grassland	Juniper Outcrop	Bottomland	Greasewood Shrubland
Iva axillaris	Poverty sumpweed	X			X	X
Lupinus spp.	Lupine	X		X		
Lygodesmia juncea	Skeletonweed	X	X			
Melilotus officinalis	Yellow sweetclover					
Phlox hoodii	Hood's phlox		X			X
Psoralea tenuiflora	Scurfpea	X	X	X		
Sphaeralcea coccinea	Globe mallow		X	X		X
Unknown forb	--				X	
Unknown aster	--				X	
Yucca glauca	Yucca		X			
Annual Forbs						
Alyssum parvifolia	Alyssum	X	X	X	X	X
Descurainia sophia	Flixweed tansymustard				X	
Kochia scoparia	Summer cypress				X	X
Lappula redowski	Blue-seed stickseed	X		X		
Madia glomerata	Tarweed				X	
Plantago patagonia	Wooley plantain	X	X		X	X
Unknown annual forb			X		X	
Subshrub						
Artemisia frigida	Fringed sage	X	X	X	X	
Artemisia pedatifida	Birdfoot sage					X
Leptodactylon pungens	Granite prickly gila	X	X	X		
Gutierrezia sarothrae	Broom snakeweed	X	X	X		
Succulent						
Opuntia polyacantha	Pricklypear cactus	X	X	X		X
Shrub						
Artemisia cana	Silver sagebrush	X	X	X	X	X
Artemisia tridentata wyomingensis	Woming big sagebrush	X	X	X		X
Atriplex gardneri	Gardner's saltbush					X
Cercocarpus montanus	Mountain mahogany	X		X		
Chrysothamnus nauseosus	Rubber rabbitbrush		X	X		
Chrysothamnus viscidiflorus	Douglas rabbitbrush			X		X
Krascheninnikovia lanata	Winterfat	X	X	X	X	
Rhus trilobata	Skunkbush			X		
Sarcobatus vermiculatus	Greasewood					
Symphoricarpos occidentalis	Snowberry			X		
Trees						
Juniperus scopulorum	Rocky Mounain juniper			X		
Pinus flexilis	Limber pine			X		
Populus deltoides	Plains cottonwood	X			X	

ADDENDUM D8C:

COVER DATA BY TRANSECT FOR
EACH VEGETATION COMMUNITY SAMPLED

Table D8C-1 Number of Hits by Transect, Life Form, and Species, Sagebrush Shrubland, Nichols Ranch ISR Project, 2006.

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Perennial Grass																				
Aristida purpurea longiseta																				2
Bouteloua gracilis			2				1	1		2	2		1		1			1		
Calamovilfa longifolia								2												
Elymus spicatus		0			2				1							6				
Elymus smithii							6													
Koeleria macrantha	1		1		1		2				1	2	3	1				1		1
Poa secunda	1	2	2	2		4		4	2	2	6	2	1	5	3	4	1	4	4	
Oryzopsis hymenoides																2				
Stipa comata	1	1	7		1	1	1	5	3	1	1	4	4	3	4	4	2	5	1	5
Stipa viridula														2						
Subtotal	3	3	12	2	4	5	10	12	6	5	10	8	9	11	8	16	3	11	5	8
Annual Grasses																				
Festuca octoflora	1		1			1		1	1	2	3		3						1	
Bromus japanicus						3	11			4	1	5								
Bromus tectorum	2	2	2	1	5			3	2		6	1	1			2		1	6	
Subtotal	3	2	3	1	5	4	11	4	3	6	10	6	4	0	0	2	0	1	7	0
Other Grasslike Species																				
Carex filifolia	1	3	1	1	6	1		1	3	6	2	2	6	1	4	4	2	1	9	11
Subtotal	1	3	1	1	6	1	0	1	3	6	2	2	6	1	4	4	2	1	9	11
Perennial Forb																				
Lygodesmia juncea																2				
Psoralea tenuiflora								1												
Subtotal	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
Annual Forbs																				
Alyssum parvifolia	2	1	1	4		1	1			1	2			3		1	2	1	1	
Lappula redowski																			1	
Plantago patagonia	1				1	2		1		1			2		1			2	1	1
Subtotal	3	1	1	4	1	3	1	1	0	2	2	0	2	3	1	1	2	3	3	1

Table D8C-1 (Continued)

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Subshrub																				
Artemisia frigida													1							
Leptodactylon pungens													1				1			
Gutierrezia sarothrae									1						1					
Subtotal	0	0	0	0	0	0	0	0	1	0	0	0	2	0	1	0	1	0	0	0
Succulent																				
Opuntia polyacantha			1							1	1							2	1	
Subtotal	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	1	0
Shrub																				
Artemisia cana																1				
Artemisia tridentata wyomingensis	17	14	8	11	8	9	9	7	9	7	8	5	6	7	9	1	17	5	4	3
Cercocarpus montanus														1						
Krascheninnikovia lanata	1											1								
Subtotal	18	14	8	11	8	9	9	7	9	7	8	6	6	8	9	2	17	5	4	3
Total No. of Vegetative Hits	28	23	26	19	24	22	31	26	22	27	33	22	29	23	23	27	25	23	29	23
% Vegetative Cover	56	46	52	38	48	44	62	52	44	54	66	44	58	46	46	54	50	46	58	46
Litter	12	13	16	16	15	12	7	10	10	13	9	12	9	11	12	17	10	17	10	13
Rock									4											1
Subtotal	12	13	16	16	15	12	7	10	14	13	9	12	9	11	12	17	10	17	10	14
Total No. of Ground Cover Hits	40	36	42	35	39	34	38	36	36	40	42	34	38	34	35	44	35	40	39	37
% Total Ground Cover	80	72	84	70	78	68	76	72	72	80	84	68	76	68	70	88	70	80	78	74
Bare Ground No. of Hits	10	14	8	15	11	16	12	14	14	10	8	16	12	16	15	6	15	10	11	13
% Bare Ground	20	28	16	30	22	32	24	28	28	20	16	32	24	32	30	12	30	20	22	26

Table D8C-2 Number of Hits by Transect, Life Form, and Species, Mixed Grassland, Nichols Ranch ISR Project, 2006.

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Perennial Grass																				
Agropyron cristatum																	1			
Aristida purpurea longiseta																		1		
Bouteloua gracilis		1			2	3	2	2	1				6	2		4		1	2	
Calamovilfa longifolia		1							1											
Elymus spicatus			1			6				1	1									
Elymus smithii	6	3														2		1	3	
Koeleria macrantha			3					1	1		1			2	1	1		1		2
Poa secunda				5	3		5		1	3	1	4	1	2	2	2	1	1	3	4
Oryzopsis hymenoides		2																		
Stipa comata		2	1	9	7	1	5	6	4	4	4		3	9	7	2	2	2	3	2
Stipa viridula												2								1
Subtotal	6	9	5	14	12	10	12	9	8	8	7	6	10	15	10	11	4	7	11	9
Annual grasses																				
Festuca octoflora							1													4
Bromus japanicus												6								2
Bromus tectorum	3	4		9					3						1			1		1
Subtotal	3	4	0	9	0	0	1	0	3	0	0	6	0	0	1	0	0	1	0	7
Other Grasslike Species																				
Carex filifolia		10	7	3	8	12	12	11	8	10	11	5	8	6	5	14	11	10	9	2
Subtotal	0	10	7	3	8	12	12	11	8	10	11	5	8	6	5	14	11	10	9	2
Perennial Forb																				
Eriogonum spp.								1												
Heterotheca villosa			1							2										
Phlox hoodii										1										
Psoralea tenuiflora		1					1		1				1							
Sphaeralcea coccinea	1					1					1								1	
Unknown forb		1																		
Yucca glauca		1																		
Subtotal	1	3	1	0	0	1	1	1	1	3	1	0	1	0	0	0	0	0	1	0

Table D8C-2 (Continued)

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Annual Forbs																				
Alyssum parvifolia												2	1			1				3
Plantago patagonia					1	4						3			3				2	
Unknown annual forb									1											
Subtotal	0	0	0	0	1	4	0	0	1	0	0	5	1	0	3	1	0		2	0
Subshrub																				
Artemisia fridiga													2							
Leptodactylon pungens		1	2						1	1										
Gutierrezia sarothrae																	2			
Subtotal	0	1	2	0	0	0	0	0	1	1	0	0	2	0	0	0	2	0	0	0
Succulent																				
Opuntia polyacantha	2			2		1			1					1		1				
Subtotal	2	0	0	2	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0
Shrub																				
Artemisia cana		1																		
Artemisia tridentata wyomingensis			3					1			3	2			4	1	3	1		
Chrysothamnus viscidiflorus																1				
Krascheninnikovia lanata												1								
Subtotal	0	1	3	0	0	0	0	1	0	0	3	3	0	0	4	2	3	1	0	0
Total No. of Hits	12	28	18	28	21	28	26	22	23	22	22	25	22	22	23	29	20	19	23	21
% Vegetative Cover	24	56	36	56	42	56	52	44	46	44	44	50	44	44	46	58	40	38	46	42
Litter	20	11	14	19	12	8	10	10	13	9	15	13	5	15	12	13	7	8	8	25
Rock		1	2				3						7				3	2		
Subtotal	20	12	16	19	12	8	13	10	13	9	15	13	12	15	12	13	10	10	8	25
Total No. of Ground Cover Hits	32	40	34	47	33	36	39	32	36	31	37	38	34	37	35	42	30	29	31	46
% Total Ground Cover	64	80	68	94	66	72	78	64	72	62	74	76	68	74	70	84	60	58	62	92
Bare Ground No. of Hits	18	10	16	3	17	14	11	18	14	19	13	12	16	13	15	8	20	21	19	4
% Bare Ground	36	20	32	6	34	28	22	36	28	38	26	24	32	26	30	16	40	42	38	8

Table D8C-3 Number of Hits by Transect, Life Form, and Species, Juniper Outcrop, Nichols Ranch ISR Project, 2006.

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Perennial Grass																				
Bouteloua gracilis				1														7		
Calamovilfa longifolia		2																		
Elymus cinereus									10										2	
Elymus spicatus		1	1		2	1	1	1			2	5	3	4		3	1	1	1	
Koeleria macrantha	3				1			1	1	1		2	2	1						
Poa secunda	1										2									1
Poa spp.			1																	
Oryzopsis hymenoides		2						1					3			1				1
Stipa comata	5	6	8	3	1		3	5	1	2		3	6	3	1	1	2	1	2	
Unknown perennial grass				1																
Subtotal	9	11	10	5	4	1	4	8	12	3	4	10	14	8	1	5	3	9	5	2
Annual Grasses																				
Bromus japanicus										1										
Bromus tectorum			5		6			4	5				1	1	4			2	4	1
Subtotal	0	0	5	0	6	0	0	4	5	1	0	0	1	1	4	0	0	2	4	1
Other Grasslike Species																				
Carex filifolia	3	2	1	5	1	3					7		1				2			1
Subtotal	3	2	1	5	1	3	0	0	0	0	7	0	1	0	0	0	2	0	0	1
Perennial Forb																				
Achillea millefolium																	1			
Arenaria hookeri														2						
Astragalus bisulcatus						1														1
Cirsium arvense									1										1	
Chaenactis douglasii																				2
Heterotheca villosa			1																	
Lupinus spp.							1													
Phlox hoodsii																				
Psoralea tenuiflora								2				2				2	1		2	
Sphaeralcea coccinea																				1
Unknown forb																				1
Unknown aster							2													
Subtotal	0	0	1	0	0	1	3	2	1	0	0	2	1	2	0	2	2	0	3	5
Annual Forbs																				
Alyssum parvifolia			1		1					3					2	2		2		1
Lappula redowski																		1		
Subtotal	0	0	1		1					3					2	2		3		1

Table D8C-3 (Continued)

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Subshrub																				
Artemisia frigida						1														
Leptodactylon pungens																1	1			
Gutierrezia sarothrae		2						1	2		1		1	1					2	1
Subtotal	0	2	0	0	0	1	0	1	2	0	1	0	1	1	0	1	1	0	2	1
Succulent																				
Opuntia polyacantha			2																	
Subtotal	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrub																				
Artemisia cana																				
Artemisia tridentata wyomingensis	8	5	4	12	9	4	2	10	8		2	1	1	9	9	2		6	3	5
Chrysothamnus nauseosus																				1
Chrysothamnus viscidiflorus							1													
Krascheninnikovia lanata				2		1							1							
Rhus trilobata		1																		
Symphoricarpos occidentialis									2					1						
Subtotal	8	6	4	14	9	5	3	10	10	0	2	1	2	10	9	2	0	6	3	6
Trees																				
Juniperus scopulorum		1	1		8					27	3	2		4	5	8	4		4	
Pinus flexilis												3								
Subtotal	0	1	1		8					27	3	5		4	5	8	4		4	
Total No. of Vegetative Hits	20	22	25	24	29	11	10	25	30	34	17	18	20	26	21	20	12	20	21	17
% Vegetative Cover	40	44	50	48	58	22	20	50	60	68	34	36	40	52	42	40	24	40	42	34
Litter	6	1	12	12	3	5	2	4	12	2	7	9	9	4	13	5	10	6	3	6
Rock	15	16	5	1	6	6	4	2	1	5	12	11	1	10	8	12	15	2	8	7
Subtotal	21	17	17	13	9	11	6	6	13	7	19	20	10	14	21	17	25	8	11	13
Total No. of Ground Cover Hits	41	39	42	37	38	22	16	31	43	41	36	38	30	40	42	37	37	28	32	30
% Total Ground Cover	82	78	84	74	76	44	32	62	86	82	72	76	60	80	84	74	74	56	64	60
Bare Ground No. of Hits	9	11	8	13	12	28	34	19	7	9	14	12	20	10	8	13	13	22	18	20
% Bare Ground	18	22	16	26	24	56	68	38	14	18	28	24	40	20	16	26	26	44	36	40

Table D8C-4 Number of Hits by Transect, Life Form, and Species, Bottomland, Nichols Ranch ISR Project, 2006.

	Transect																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Perennial Grass																				
Bromus inermis	12	3	1		12			3		1		1		1	4					
Distichlis stricta	1	3							8		1					1				
Elymus intermedium													4	4						
Elymus smithii	8	6	12	22	6	11	15	11	10	19	10	22	6		8	16	18	5	5	7
Hordeum jubatum		6							5					10		4				
Koeleria macrantha																2				
Poa secunda	5								3			2				1				
Poa spp.							1		1	2					1	1				
Sporobolus airoides	1																			
Unknown perennial grass		3																		
Subtotal	27	21	13	22	18	11	16	14	27	22	11	25	10	15	13	25	18	5	5	7
Annual Grasses																				
Bromus tectorum	2	1	1	3		16	1	11	5		7		3	2	2	1	7	8	9	7
Subtotal	2	1	1	3	0	16	1	11	5	0	7	0	3	2	2	1	7	8	9	7
Other Grasslike Species																				
Carex filifolia	1																			
Carex praegracilis																4				
Equisetum spp.	5															1				
Juncus balticus		1																		
Subtotal	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Perennial Forb																				
Achillea millefolium																2				
Asclepias specious												1								
Cirsium arvense	2				2	1						1		3					1	
Grindellia squarosa																1	1			
Melilotus officinalis					1															
Unknown forb		1																		
Unknown aster			2								1						2	1		
Subtotal	2	1	2	0	3	1	0	0	0	0	1	2	0	3	0	3	3	1	1	0

Table D8C-4 (Continued)

	Transect																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Annual Forbs																				
Alyssum parvifolia																		3		
Descurainia sophia		3		3						1	1									
Kochia scoparia		3	7	4	1	3	4	3	2	5	1	1	8	3	5			2	11	11
Madia glomerata																3				
Plantago patagonia												1								
Unknown annual forb		1																		
Subtotal	0	7	7	7	1	3	4	3	2	6	2	2	8	3	5	3	0	5	11	11
Subshrub																				
Artemisia frigida	3																			
Subtotal	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrub																				
Artemisia cana	1																			
Krascheninnikovia lanata																	0			
Subtotal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total No. of Hits	41	31	23	32	22	31	21	28	34	28	21	29	21	23	20	37	28	19	26	25
% Vegetative Cover	82	62	46	64	44	62	42	56	68	56	42	58	42	46	40	74	56	38	52	50
Litter	9	14	25	17	19	16	25	21	13	21	27	15	20	23	22	12	15	20	19	21
Rock																				
Subtotal	9	14	25	17	19	16	25	21	13	21	27	15	20	23	22	12	15	20	19	21
Totl No. of Ground Cover Hits	50	45	48	49	41	47	46	49	47	49	48	44	41	46	42	49	43	39	45	46
% Total Ground Cover	100	90	96	98	82	94	92	98	94	98	96	88	82	92	84	98	86	78	90	92
Bare Ground No. of Hits	0	5	2	1	9	3	4	1	3	1	2	6	9	4	8	1	7	11	5	4
% Bare Ground	0	10	4	2	18	6	8	2	6	2	4	12	18	8	16	2	14	22	10	8

Table D8-C-5 Number of Hits by Transect, Life Form, and Species, Greasewood Shrubland, Nichols Ranch ISR Project, 2006.

	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Perennial Grass															
Bouteloua gracilis						1	1						2	1	
Distichlis stricta								1							
Elymus spicatus								1		2	1				
Elymus smithii		1		1		3	5	4					8		8
Koeleria macrantha									2						1
Poa secunda	6	2		1	1	2			2	1	5	1		1	
Oryzopsis hymenoides			3		4			1							
Sporobolus airoides			2												
Stipa comata		4		2				2			3			7	
Subtotal	6	7	5	4	5	6	6	9	4	3	9	1	10	9	9
Annual grasses															
Bromus japanicus										3					
Bromus tectorum	7	14	12	4	8	10	1	4	5	16	10	15	5	3	9
Subtotal	7	14	12	4	8	10	1	4	5	19	10	15	5	3	9
Other Grasslike Species															
Carex filifolia		3		3					5		1		3	15	
Subtotal	0	3	0	3	0	0	0	0	5	0	1	0	3	15	0
Perennial Forb															
Phlox hoodii							1	1							
Sphaeralcea coccinea	1														
Unknown forb	1						2								
Subtotal	2	0	0	0	0	0	3	1	0	0	0	0	0	0	0
Annual Forbs															
Alyssum parvifolia	1	1	1	4	1		1	4	1	2	4		2		4
Kochia scoparia			1							1		2			
Plantago patagonia		1				2			1		2	2	2	3	
Subtotal	1	2	2	4	1	2	1	4	2	3	6	4	4	3	4

Table D8C-5 (Continued).

	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Subshrub															
Artemisia pedatifida	2					3	5	1							3
Subtotal	2	0	0	0	0	3	5	1	0	0	0	0	0	0	3
Succulent															
Opuntia polyacantha		3		6	2		1	1	4		4		4	3	
Subtotal	0	3	0	6	2	0	1	1	4	0	4	0	4	3	0
Shrub															
Artemisia cana								1							
Artemisia tridentata wyomingensis		1			4			1	6	5				2	
Atriplex gardneri						1									
Chrysothamnus viscidiflorus	2														
Sarcobatus vermiculatus		3	4	3	3	5		2	1	4	1	5	3		2
Subtotal	2	4	4	3	7	6	0	4	7	9	1	5	3	2	2
Total No. of Hits	20	33	23	24	23	27	17	24	27	34	31	25	29	35	27
% Vegetative Cover	40	66	46	48	46	54	34	48	54	68	62	50	58	70	54
Litter	4	11	27	18	17	3	4	12	10	9	12	17	14	4	4
Rock															
Subtotal	4	11	27	18	17	3	4	12	10	9	12	17	14	4	4
Total No. of Ground Cover Hits	24	44	50	42	40	30	21	36	37	43	43	42	43	39	31
% Total Ground Cover	48	88	100	84	80	60	42	72	74	86	86	84	86	78	62
Bare Ground No. of Hits	26	6	0	8	10	20	29	14	13	7	7	8	7	11	19
% Bare Ground	52	12	0	16	20	40	58	28	26	14	14	16	14	22	38

ADDENDUM D8D:

CORRESPONDENCE WITH THE U.S. FISH AND WILDLIFE SERVICE AND THE WYOMING NATURAL DIVERSITY DATABASE

11-7-06
RAS ✓
SWK ✓

D8D-2

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

NOV 16 2006

In Reply Refer To:
ES-61411/Mines/WY07TA0032

Roger Schoumacher
TRC Mariah Associates Inc.
Project Manager
605 Skyline Drive
Laramie, WY 82070-8909

Dear Mr. Schoumacher:

This is in response to your letter dated October 25, 2006, received in our office on October 26, requesting a list of threatened, endangered, proposed, and candidate species for a proposed *in situ* uranium recovery project in Campbell and Johnson counties, Wyoming (T75-76W, R43-44N). We are providing you with information on (1) threatened, endangered and candidate species, (2) migratory birds, (3) wetlands and riparian areas, (4) sensitive species, and (5) water quality. The U.S. Fish and Wildlife Service (Service) provides recommendations for protective measures for threatened and endangered species in accordance with the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Protective measures for migratory birds are provided 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 and the Fish and Wildlife Act of 1956, as amended, 70 Stat. 1119, 16 U.S.C. 742a-742j.

In accordance with Section 7(c) of the Act, my staff has determined that the following listed species may be present in the proposed project area in Campbell and Johnson counties, Wyoming. We would appreciate receiving information as to the current status of each of these species within the proposed project area.

SPECIES	STATUS	HABITAT
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Found throughout state
Black-footed ferret (*Mustela nigripes*)	Endangered	Prairie dog towns
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	Threatened	Seasonally moist soils and wet meadows of drainages below 7000 feet elevation

Bald eagle: While habitat loss and human disturbance remains a threat to the bald eagle's full recovery, most experts agree that its recovery to date is encouraging. 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. Because bald eagles are particularly sensitive to human disturbance at their nests and communal roosts, protective buffers should be implemented around these areas [Buehler et al. 1991, Greater Yellowstone Bald Eagle Working Group (GYBEWG) 1996, Montana Bald Eagle Working Group (MBEWG) 1994, Stalmaster and Newman 1978, U.S. Fish and Wildlife Service (USFWS) 1986].

In Wyoming, bald eagle nest buffer recommendations include avoiding project-related disturbance and habitat alteration within 1 mile of bald eagle nests. The nesting season occurs from February 1 to August 15 and bald eagle nest buffers should receive maximum protection during this time period. For some activities (construction, seismic exploration, blasting, and timber harvest), a home range buffer may include potential foraging habitat for 2.5 miles from the nest (GYBEWG 1996). We recommend that you contact the U.S. Fish and Wildlife Service to determine the potential impact of your activity to nesting bald eagles if your project will cause disturbance within one of these nest buffer areas.

A communal roost is defined as an area where six or more eagles spend the night within 100 meters (328 feet) of each other (GYBEWG 1996). For bald eagle communal winter roosts, we recommend that disturbance be restricted within 1 mile of known communal winter roosts during the period of November 1 to April 1. Additionally, we recommend avoiding disturbance and habitat alteration within 0.5 mile of active roost sites year round.

Disturbance sensitivity of roosting and nesting bald eagles may vary between individual eagles, topography, density of vegetation and intensity of activities. The buffers and timing stipulations, as described above, should be implemented unless site-specific information indicates otherwise (Stalmaster and Newman 1978, USFWS 1986). Modification of buffer sizes may be permitted where biologically supported and in coordination with the Service.

Black-footed ferret: Black-footed ferrets may be affected if prairie dog towns are impacted. Please be aware that black-footed ferret surveys are no longer recommended in black-tailed prairie dog towns statewide. However, we encourage protection of all prairie dog towns for their value to the prairie ecosystem and the myriad of species that rely on them. We further encourage you to analyze potentially disturbed prairie dog towns for their value to future black-footed ferret reintroduction.

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 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.

Migratory Birds

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. In addition, we have enclosed a list of Migratory Bird Species of Management Concern in Wyoming (Migratory Birds of High Federal Interest) for use in your analysis.

Work that could lead to the take of a migratory bird including an eagle, their young, eggs, or nests (for example, if you are going to construct roads, or power lines in the vicinity of a nest), should be coordinated with our office before any actions are taken. 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.

Wetland and Riparian Areas

Wetlands associated with streams, creeks, and rivers 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. The Service recommends measures be taken to avoid and minimize wetland losses in accordance with Section 404 of the Clean Water Act, and Executive Order 11988 (floodplain management) as well as the goal of "no net loss of wetlands." 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.

Greater Sage-Grouse:
As you know, the Service has determined that the greater sage-grouse (*Centrocercus urophasianus*) is unwarranted for listing at this time. However, the Service continues to have concerns regarding sage-grouse population status, trends and threats, as well as concerns for other sagebrush obligates. The following information is provided for your use in the evaluation of proposed actions and their potential effects to the sage-grouse.

Greater sage-grouse are dependent on sagebrush habitats year-round. 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 (Braun 1998, Wisdom et al. 2002). 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 1 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 mitigative measures to minimize potential impacts from the proposed 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.

Water Quality

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). Boon (1989) reported that uranium deposits in Converse County, Wyoming, can contain up to 4,500 µg/g (ppm) of selenium. In situ mining of uranium is done by injecting a leaching solution of native ground water containing dissolved oxygen and carbon dioxide into the uranium-bearing formation through injection wells. The leaching solution dissolves selenium present in the formation. 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. Another disposal option that is not commonly used involves land application using center-pivot irrigation after treatment for removal of uranium and radium.

In 1998, the Service conducted a study of a 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. 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 µg/L are considered hazardous to the health and long-term survival of fish and wildlife (Lemly 1996). Additionally, water with more than 20µg/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 µg/g in pondweed (*Potamogeton vaginatus*) collected from a uranium mine wastewater storage reservoir that had waterborne selenium concentrations ranging from 260 to 350 µg/L. The potential for wastewater disposal to mobilize selenium through terrestrial and aquatic food chains should be assessed to assist in selecting a wastewater disposal option which would avoid or minimize impacts to fish and wildlife resources.

We appreciate your efforts to ensure the conservation of endangered, threatened, and candidate species and migratory birds. When the lead Federal agency for this project is determined, please coordinate with the Buffalo Field Office of the BLM or the Nuclear Regulatory Commission (NRC) in Arlington, Texas. If you have further questions regarding our comments or your responsibilities under the Act, please contact Jan McKee of my staff at the letterhead address or phone (307) 772-2374, extension 242.

Sincerely,

Patricia Deibert

for Brian T. Kelly
Field Supervisor
Wyoming Field Office

cc: NRC, Arlington, Texas
WDEQ, Land Quality Division, Sheridan, WY,
WGFD, Cheyenne, WY, Statewide Habitat Protection Coordinator (V. Stelter)
WGFD, Lander, WY, Non-game Coordinator (B. Oakleaf)

Enclosure

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Enclosure 1

Migratory Bird Species of Management Concern in Wyoming

(Migratory Birds of High Federal Interest)

Based on the *Wyoming Bird Conservation Plan* (Cerovski et al. 2000)

May 2, 2002

U.S. Fish and Wildlife Service, Wyoming Field Office,
4000 Airport Parkway, Cheyenne, Wyoming 82001

The Wyoming Field Office of the U.S. Fish and Wildlife Service (Service) has compiled the following list from the ongoing work among State and Federal agencies, non-governmental organizations, and the interested public that produced the Wyoming Bird Conservation Plan. This list will now serve as the Service's list of Migratory Bird Species of Management Concern in Wyoming, in place of the previous list based on the Migratory Nongame Birds of Management Concern in the United States: the 1995 List. The Wyoming Bird Conservation Plan identified priority species based on a number of criteria (see below) using the best information available for these generally un-studied species. In many cases, this list reflects identified threats to habitat because no information is available on the species population trends. In some cases it reflects identified population declines though no causal factors have been identified.

The following tables and explanatory text are taken directly from the Wyoming Bird Conservation Plan (Cerovski et al. 2000). For more information on this listing process, this report is available from the Service's Wyoming Field Office, 4000 Airport Parkway, Cheyenne, Wyoming 82001; or Wyoming Game and Fish Department (WGFD), Nongame Branch, 260 Buena Vista, Lander, Wyoming 82520.

Table 1. **Level I Species (Conservation Action).** Species clearly needs conservation action. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, and the need for additional knowledge through monitoring and research into basic natural history, distribution, etc.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Mountain Plover[d]	28	4	3	Shortgrass Prairie, Shrub-steppe
Trumpeter Swan	26	3	3	Wetlands
Sage Grouse	26	5	3	Shrub-steppe
McCown's Longspur	26	3	2	Shortgrass Prairie, Shrub-steppe
Baird's Sparrow	26	2	3	Shortgrass Prairie
Ferruginous Hawk	23	4	3	Shrub-steppe, Shortgrass Prairie

Table 1. **Level I Species (Conservation Action)**, continued.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Brewer's Sparrow	23	5	5 Shrub	Shrub-steppe, Mountain-foothills
Wilson's Phalarope	22	3	5	Wetlands
Franklin's Gull	22	3	3	Wetlands
Sage Sparrow	22	5	2	Shrub-steppe, Mountain-foothills Shrub
Swainson's Hawk	21	3	3	Plains/Basin Riparian
Long-billed Curlew	21	2	3	Shortgrass Prairie
Short-eared Owl	20	3	3	Shortgrass Prairie
Northern Goshawk	19	4	3	High Elevation Conifer, Mid Elevation Conifer, Aspen
Peregrine Falcon	19	3	3	Specialized (cliffs)
Burrowing Owl	19	3	4	Shortgrass Prairie
Forster's Tern	19	2	3	Wetlands
Bald Eagle	18	3	3	Montane Riparian, Plains/Basin Riparian
Upland Sandpiper	18	2	2	Shortgrass Prairie
Black Tern	18	3	3	Wetlands
Whooping Crane	n/a	n/a	n/a	Wetlands
Piping Plover	n/a	n/a	n/a	Wetlands, Aquatic

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database, Carter et al. 1997).
[c] PT = Population Trend (from the PIF Priority Database, Carter et al. 1997).
[d] Species in all capital letters previously appeared on the Service's 1995 list.

Table 2. **Level II Species (Monitoring).** The action and focus for the species is monitoring. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, species whose population trend is unknown, species that are peripheral for breeding in the habitat or state, or species for which additional knowledge is needed.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Calliope Hummingbird	23	5	3	Mid Elevation Conifer, Montane Riparian
Lewis' Woodpecker	23	3	3	Low Elevation Conifer, Plains/Basin Riparian
Cassin's Kingbird	22	3	3	Juniper Woodland, Plains/Basin Riparian
Lark Bunting	22	4	4	Shortgrass Prairie, Shrub-steppe
American White Pelican	21	3	3	Aquatic
Williamson's Sapsucker	21	3	3	Mid Elevation Conifer
Black-backed Woodpecker	21	3	3	Mid Elevation Conifer, High Elevation Conifer
Gray Flycatcher	21	3	3	Juniper Woodland, Mountain-foothills Shrub
Juniper Titmouse [d]	21	3	3	Juniper Woodland
Dickcissel	21	3	3	Shortgrass Prairie
Chestnut-collared Longspur	21	2	3	Shortgrass Prairie
Harlequin Duck	20	3	3	Montane Riparian
Snowy Plover	20	3	3	Wetlands
Black-chinned Hummingbird	20	2	3	Plains/Basin Riparian, Shrub-steppe
Rufous Hummingbird	20	2	3	Mid Elevation Conifer
Red-naped Sapsucker	20	3	2	Aspen
Three-toed Woodpecker	20	4	3	Mid Elevation Conifer, High Elevation Conifer
Willow Flycatcher	20	3	4	Montane Riparian, Plains/Basin Riparian
Hammond's Flycatcher	20	2	3	High Elevation Conifer with Aspen, Montane Riparian
Cordilleran Flycatcher	20	3	3	Montane Riparian, Mid Elevation Conifer
Pygmy Nuthatch	20	3	3	Low Elevation Conifer
Marsh Wren	20	3	4	Wetlands
American Dipper	20	3	3	Montane Riparian

Table 2. **Level II Species (Monitoring)**, continued.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Plumbeous Vireo	20	3	3	Mid Elevation Conifer, Low Elevation Conifer
Townsend's Warbler	20	3	3	High Elevation Conifer, Mid Elevation Conifer
Dusky Flycatcher	19	3	2	Low Elevation Conifer, Aspen, Mountain-foothills Shrub
Western Bluebird	19	3	3	Juniper Woodland, Low Elevation Conifer
Sage Thrasher	19	5	2	Shrub-steppe
Grasshopper Sparrow	19	3	5	Shortgrass Prairie, Shrub-steppe
Bobolink	19	2	3	Shortgrass Prairie, Shrub-steppe
Common Loon	18	3	3	Wetlands
Black-billed Cuckoo	18	2	3	Plains/Basin Riparian
Red-headed Woodpecker	18	2	3	Plains/Basin Riparian, Low Elevation Conifer
Yellow-billed Cuckoo	18	3	3	Plains/Basin Riparian
Eastern Screech-Owl	18	3	3	Plains/Basin Riparian
Western Screech-Owl	18	3	3	Plains/Basin Riparian
Great Gray Owl	18	3	3	Mid Elevation Conifer, High Elevation Conifer
Boreal Owl	18	3	3	High Elevation Conifer
Broad-tailed Hummingbird	18	2	2	Montane Riparian, Plains/Basin Riparian, Mid Elevation Conifer
Western Scrub-Jay[d]	18	3	3	Juniper Woodland
Loggerhead Shrike	18	3	3	Shrub-steppe
Vesper Sparrow	18	5	4	Shrub-steppe
Lark Sparrow	18	3	4	Shrub-steppe
Golden-crowned Kinglet	17	3	3	High Elevation Conifer
MacGillivray's Warbler	17	3	1	Montane Riparian, Plains/Basin Riparian
Ash-throated Flycatcher[d]	16	2	3	Juniper Woodland
Bushtit[d]	16	3	3	Juniper Woodland
Brown Creeper	16	3	3	Mid Elevation Conifer, High Elevation Conifer
Merlin	15	3	3	Low Elevation Conifer
Sprague's Pipit	n/a	n/a	n/a	Grassland, Plains/Basin Riparian, Shortgrass Prairie
Barn Owl	n/a	n/a	n/a	Shortgrass Prairie, Urban
White-faced Ibis	n/a	n/a	n/a	Wetlands, Aquatic

Table 2. **Level II Species (Monitoring)**, continued.

American Bittern	n/a	n/a	n/a	Wetlands, Aquatic
Common Tern	n/a	n/a	n/a	Wetlands, Aquatic
Purple Martin	n/a	n/a	n/a	Wetlands, Aquatic/Basin Riparian, Montane Riparian

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database).
[c] PT = Population Trend (from the PIF Priority Database).
[d] Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

Wyoming Partners In Flight Process for Prioritizing Species

Wyoming Partners In Flight participants developed the current list of priority species based on a combination of the seven criteria in the national Partners In Flight Priority Database (Carter et al. 1997). This database serves as a defensible method of prioritizing both species and habitats in need of conservation. The criteria include Wyoming-dependent and Wyoming-independent factors. The Wyoming-independent criteria are constant over a species' range and do not vary for each species. The Wyoming-dependent criteria were the key components used to prioritize species and their conservation action needs. In the absence of any more rigorous statewide surveys, Breeding Bird Survey data dating back to 1968 were used to determine population trends in Wyoming.

Criteria

Within each criterion below, a species was given a rank score ranging from 1 to 5, with 1 being the least critical rank and 5 the most critical. Each ranked species could potentially receive a low score of 7 and a high score of 35. However, setting conservation goals based only on total score could be misleading; therefore, each total score was reviewed in conjunction with its component parts. In Wyoming, species were initially ranked using total score, area importance, and population trend.

1. Relative Abundance (RA) - The abundance of a bird, in appropriate habitat within its entire range, relative to other bird species. This criterion gives an indication of a species' vulnerability to withstand cataclysmic environmental changes. A low score would indicate a higher relative abundance, therefore reducing the risk of complete extirpation from losses in one or more regions. Higher scores indicate a lower relative abundance, thus more vulnerability to drastic losses or population changes.

2. Breeding Distribution (BD) - A relative measure of breeding range size as a proportion of North America [defined as the main body of the continent, excluding Greenland, through Panama and the islands of the Caribbean, comprising an area of 22,059,680 km^2 (National Geographic Society 1993)], and as such it provides an index of a species' vulnerability to

random environmental events. High scores indicate localized breeding, thus a higher likelihood of serious decline from drastic environmental changes. Low scores indicate wide breeding distribution, therefore less likelihood of extirpation. Used for breeding birds only.

3. Non-breeding Distribution (ND) - A relative measure of non-breeding, or winter, range size as a proportion of North America, and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized distribution on the non-breeding grounds. Low scores indicate wide distribution on the non-breeding grounds, therefore less likelihood of extirpation. Used for wintering birds only.

4. Threats on Breeding Grounds (TB) - The ability of a habitat in an area to support populations of a species in that area. Two factors are considered here: 1) each species' demographic and ecological vulnerability (the potential inability of a species to recover from population loss by normal reproductive effort due to low reproductive rate, high juvenile mortality, or both; and the level of ecological specialization of a species and, hence, its potential inability to withstand environmental change), and 2) habitat loss or disruption (a combination of the amount of habitat or conditions necessary for survival and reproductive success that has been lost since 1945, and the amount that is anticipated to be lost in the future). High scores indicate either a large loss of habitat or a species that is an extreme ecological specialist. Low scores indicate a stable or increasing habitat or a species that is an ecological generalist. Used for both breeding and wintering birds.

5. Threats on Non-breeding Grounds (TN) - Range-wide threats on non-breeding, or winter, grounds. This is scored using the same criteria as threats on breeding grounds but reflects non-breeding issues, including migratory habitat. Used for wintering birds only.

6. Population Trend (PT) - The overall population trend of each species assigned independently for each state, province, or physiographic area. This criterion must meet two thresholds, reliability and magnitude, to warrant either a very high or very low score. When possible, a score was assigned using BBS data, which incorporated a population trend uncertainty score based on the statistical validity of the BBS data (i.e. a species must be detected on a minimum of 14 BBS routes per state for population trends to have statistical significance). This criterion was chosen to alert managers to species with modest, but certain, population declines.

7. Area Importance (AI) - The abundance of a species within a state, province, or physiographic area relative to its abundance throughout its range. This criterion helps direct conservation efforts toward areas that are most important to a species' survival. Area Importance is scored locally; therefore, high scores indicate that a large proportion of the species' breeding or winter range occurs in Wyoming, or a species is using a habitat that is only available in Wyoming. Low scores indicate that a small proportion of the species' range occurs in Wyoming, or the preferred habitat is widespread across its range. Used for both breeding and wintering birds.

Priority Species

Priority bird species in Wyoming were identified from the PIF Priority Database (Carter et al. 1997) and by qualitative, informed decisions. Those species with a total score of 18 or above, Area Importance (AI) of 3 or above, and/or Population Trend (PT) of 3 or above from the database, or with a total score less than 18 but of significant local interest were identified as the highest priority species. However, as more information becomes available, the highest priority species for Wyoming may change, as this is a dynamic database that allows for updated information to be periodically inserted and reviewed. The primary habitat type or types required for breeding were identified for each species to determine the highest priority habitat types for the state.

Literature Cited

Carter, M. F., W. C. Hunter, D. N. Pashley, J. S. Bradley, C. S. Aid, J. Price, and G. S. Butcher. 1997. Setting landbird conservation priorities for states, provinces, and physiographic areas of North America. Partners In Flight Priority Database Final Report, Colorado Bird Observatory, Brighton.

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Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

UNIVERSITY
OF WYOMING

Wyoming Natural Diversity Database
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(307) 766-3023 • fax (307) 766-3026 • e-mail: wndd@uwyo.edu • www.uwyo.edu/wyndd

30 March 2006

Roger Schoumacher
TRC Mariah Associates, Inc.
605 Skyline Drive
Laramie, WY 82070

Dear Roger,

Attached are the results of your request for documented rare species occurrences in T43-44N R74-77W, Johnson and Campbell Counties, Wyoming. A buffer of adjacent townships was also queried to provide adequate information for the appropriate application of these data. The Excel spreadsheet summarizes the results of your request.

Data are in the form of ArcView shapefiles in UTM zone 12 NAD83. The attached Data Dictionary goes over file naming conventions and defines the column headings of the fields included in your shapefiles. For additional information about abbreviations in the shapefiles please refer to the Codes and Definitions portion of our website at http://uwadmnweb.uwyo.edu/WYNDD/.

Comments from our botanist, Bonnie Heidel (307-766-3020, bheidel@uwyo.edu), and zoologist, Doug Keinath (307-766-3013, dkeinath@uwyo.edu), will be forwarded to you as soon as they have an opportunity to review the requested area and formulate responses. These files provide further information regarding potential species occurrences in the area as well as habitat information. We have no documentation of vegetation communities that we track in the area of interest.

Recommended citation:
Wyoming Natural Diversity Database. 2005. Data compilation for R. Schoumacher, completed March 30, 2006. Unpublished report. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

WYNDD would benefit greatly from the sharing of any new information on species locations that result from your project. Please contact us about our data trading policy, which would help your organization reduce costs while improving and updating our database.

We will send you a bill under separate cover for $50.00 (Tier 1 Data Request: 8 Townships x 625 taxa = 5000 (<6251)).

Thank you for your data request. Please do not hesitate to call if you have any questions about the search. We ask that you not disseminate these data, except to the Wyoming Department of Environmental Quality, without our permission.

Sincerely,
Melanie Arnett
Database Specialist
(307) 766-2296
arnett@uwyo.edu

Wyoming Natural Diversity Database

Data Request File Naming Conventions and Data Dictionary

Describes the column headings (see table) and **file naming conventions (words in bold)** for ArcView shapefiles (**.shp**) generated from our Biotics database.

A species or natural community is referred to as an Element.

eorep (Element Occurrence Representation)

An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population (*e.g.*, long distance dispersers) or a group of nearby populations (*e.g.*, metapopulation). For community Elements, the EO may represent a stand or patch of a natural community, or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries.

An Element Occurrence Representation (EOREP) is a data management tool that has both spatial and tabular components including a mappable feature and its supporting database. EOs are typically represented by bounded, mapped areas (polygons) of land and/or water. EO Representations are most commonly created for current or historically known occurrences of natural communities or native species of conservation interest. They may also be created, in some cases, for extirpated occurrences. All EOREPs encompass one or more observations (Source Features).

source (Source Feature)

Source Features represent individual observations of a specific Element at a specific place and time. They can be represented by points (**source_pt**), lines (**source_line**), or polygons (**source_poly**). If certain criteria (e.g. "evidence of breeding" or "within X kilometers of another Source Feature of the same Element with no separation barriers") are met, individual Source Features are incorporated into an Element Occurrence Representation. Source Features that do not qualify for inclusion in an EOREP remain independent (INDEPEN_SF = Y).

We are currently in the process of revising our Source Feature attribute table according to the new data methodology in Biotics. Records that have yet to be revised will only contain identification numbers and the text "HDMS DEFAULT CONVERSION VALUES" in the DESCRIPTOR field. Note that the point Source Feature for these unrevised records is equivalent to the centroid of the EO (from the old BCD methodology). Observation and survey data for these records can still be found in the EO_DATA field in EOREP files (the EOREP and related SOURCE files can be cross-referenced using the 'EO_ID' field). Please bear with us during this transitional period.

data_sensitive (separate shapefiles are made for data that are sensitive in our Biotics database)

These records are provided at the township scale only. Data are considered sensitive if they meet one or more of the following criteria:

1. Records of Source Features and/or Element Occurrences on private land that are not documented in publicly available references, but for which WYNDD has permission from the land owner to archive and disseminate at the township level.
2. Records of Source Features and/or Element Occurrences submitted to WYNDD by an outside party who has requested that the data be treated as sensitive.
3. Source Features and/or Element Occurrences that are especially sensitive to disturbance, over-harvest, over-collection, intentional destruction, or unintentional destruction.
4. Element Occurrences that encompass one or more Source Features that are considered sensitive for any reason.

boundary - The shapefile that demarcates the boundary of the request and buffer areas.

Precise information is not distributed for fields in italics: this applies to sensitive data records.

Biotics SOURCE	Biotics EOREP	DEFINITION
FEATURE_ID	FEATURE_ID	A unique identification code for the shape in Biotics.
DATA_SENS	DATA_SENS	Data are sensitive: Y - Yes. *Specific location is not released.* Data are found in separate shapefiles at the township scale. N - No.
Area	Area	Request or Buffer Area Request - Occurrence intersects the request area. Buffer - Occurrence intersects the buffer area only.
ELEM_TYPE	ELEM_TYPE	Taxonomic grouping of Element.
ELCODE	ELCODE	Element code assigned to each species by NatureServe.
SNAME	SNAME	Scientific name.
COMNAME	COMNAME	Common name.
G_RANK	G_RANK	Global Heritage rank assigned by NatureServe.
S_RANK	S_RANK	State Heritage rank assigned by WYNDD biologists.
USFWS_ESA	USFWS_ESA	Status under the United States Fish and Wildlife Service Endangered Species Act.
AGENCYSTAT	AGENCYSTAT	Status assigned by: United States Forest Service: S-USFS R2 - Sensitive in Region 2 S-USFS R4 - Sensitive in Region 4 Wyoming Bureau of Land Management: WY BLM SSL - On Sensitive Species List Wyoming Game and Fish Department: CWCS - Species part of Comprehensive Wildlife Conservation Strategy NSS1-NSS7 - Native Species Status with NSS1 being the most imperiled
TRACKSTAT	TRACKSTAT	Tracking Status: Y - Element tracked by WYNDD. W - Element watched for potential tracking.
	COUNTY	County name.
OBS_DATE	SURVEYDATE FIRST_OBS LAST_OBS	❖ SOURCE - OBS_DATE Observation date(s). ❖ EOREP - SURVEY DATE Date of the last known survey at this location. ❖ EOREP - FIRST_- and LAST_OBS The first and last date, respectively, the Element was observed at this location.
LOCATOR	TOWN_RANGE *SECTION*	❖ SOURCE - LOCATOR Township/Range/*Section* (format: 045N118W *Sec 23 SE4) and sometimes a brief description of specific location.* ❖ EOREP - TOWN_RANGE and *SECTION* Township/Range and *Section.*
TRS_NOTE	*TRS_NOTE*	*Township/Range/Section comments. Usually ¼ ¼ sections.*
OBSERVER		*Observer.* EOREP - nested in the EO_DATA field.
OBS_DATA	*EO_DATA_1* *EO_DATA_2 etc.*	*Details of each observation, including biological.* EOREP EO_DATA_2 etc... Long records are carried over into the next field.
LITERATURE	*BESTSOURCE*	❖ *SOURCE - LITERATURE* *Literature source for specific observation.* ❖ *EOREP - BESTSOURCE* *The best source of information for the EOREP.*
	SPECIMEN	*Specimen or voucher information.*
	MAPSHEET	*USGS 1:24000 state quad code.*
	DIRECTIONS_1 *DIRECTIONS_2 etc.*	*Directions to, or description of, the location.* EOREP DIRECTIONS_2 etc... Long records are carried over into the next field.
	GEN_DESC_1 *GEN_DESC_2 etc.*	*General habitat description for the location.* EOREP GEN_DESC_2 etc... Long records are carried over into the next field.
		Documentation comments.
	MIN_ELEV	*Minimum elevation in feet.*
	MAX_ELEV	*Maximum elevation in feet.*
	MANAGED_BY	*Land management area (i.e. agency land ownership).*
EO_ID	*EO_ID*	*Identification number for the Element Occurrence (EO).*

Biotics SOURCE	Biotics EOREP	DEFINITION
EO_NUM	*EO_NUM*	*Element Occurrence number for the Element.*
INDEPEN_SF		*Independent Source Feature:* *Y - Yes, Source Feature did not qualify for inclusion in an EOREP.* *N - No, Source Feature is part of an EOREP.*
SOURCE_ID		*Identification number for the Source Feature in Biotics.*
ID_CONFIRM	*ID_CONFIRM*	*Indicates whether identification has been confirmed by a reliable individual:* *Y - Yes* *N - No* *?/Q - Questionable* *U - Unknown*
BUFFERDIST *DIST_UNIT*	*PRECISION* *ACCURACY*	❖ *SOURCE - BUFFERDIST* *Estimated accuracy of the location given as a buffered distance (represented in the EOREP shapefile).* ❖ *SOURCE - DIST_UNIT* *Unit of distance measure for BUFFERDIST.* ❖ *EOREP - PRECISION* *Estimated precision of the data (old method, carried over from previous system; as records are updated in Biotics this value is deleted and the next field is populated):* *G - Low - within 7.5 km* *M - Medium - within 700* *S - High - within 20 m* ❖ *EOREP – ACCURACY* *Estimated accuracy of the data (new method, populated as data are updated in Biotics):* *Very High (>95%)* *High (>80%, <=95%)* *Medium (>20%, <=80%)* *Low (>0%, <=20%)* *Unknown*
	EO_RANK	*EO Rank; an estimate of the relative value or viability of the Element Occurrence.*
DESCRIPTOR	*EO_TYPE*	*A brief description of the Source Feature or Element Occurrence.* *When the DESCRIPTOR field in Biotics SOURCE files is populated with "HDMS DEFAULT CONVERSION VALUES", use the EOREP file to view data by cross-referencing EO_ID. We are currently in transition from the old BCD methodology to Biotics.*
	SURVEYTYPE	*Survey type.*
	SIZE_OF_EO	*Size of EO in acres unless otherwise noted.*
	INVENT_COM	*Inventory comments.*

ZOOLOGICAL COMMENTS

Wyoming Natural Diversity Database

Prepared for: Roger Schoumacher - TRC Mariah Associates, Inc.
Date: 31 March 2006
Project Description: WDEQ mine permit for an in-situ uranium mine. T43-44N R74-77W, Johnson and Campbell Counties, Wyoming

HABITAT NOTES:

Towns: The request area is ca 10-33 miles west of Wright.
Water: The Belle Fourche and Dry Fork Powder Rivers flow through the request area along with the following creeks: All Night, Big Willow Bullwhacker, Cottonwood, East Fork Bullwhacker, Fourmile, Greasewood, House, Little Bullwhacker, Little Willow, Mud Spring, North Cottonwood, North Fourmile, North Prong Willow, Seventeenmile, South All Night, South Prong Pumpkin, West Fork Bullwhacker, and Willow. At least 15 small reservoirs and/or ponds/lakes are found in the request area.
Habitat: The request area consists of Grass Riparian, Irrigated Crops, Mixed-Grass Prairie, Ponderosa Pine, and Wyoming Big Sage Steppe.
Approximate Elevation: 4,400-6,000 ft.

ZOOLOGY COMMENTS:

Please report new occurrences of any of these species to WYNDD so that our database continues to be current and useful to future requesters. Thank you!

These data represent what we currently have in our Biotics database as well as our informed opinion about what might occur in the request area if local habitat is appropriate (**species documented in our Biotics database are presented in bold face type**). Please note that absence of a species occurrence in our database is not proof that the species in question does not exist there. It is highly possible that people have never looked for, or reported, information on the species in question in the request area. Our data for private land is particularly sparse, so absence of observations on private parcels should be viewed with caution. Also, please note that (in general) only animals likely to breed or winter near the project area have been included in this list. Other animals, particularly migratory birds, may use portions of the study area in other seasons. Finally, this list includes only species that we actively track in our database, the full list of which can be found on our website (http://uwadmnweb.uwyo.edu/wyndd/).

Prepared by: Melanie Arnett, Database Specialist, arnett@uwyo.edu
Direct questions to: Doug Keinath, Zoologist; dkeinath@uwyo.edu

Bold = Documented in our Biotics database. * = Documented request area.

Sensitive BIRDS Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Bald eagle	Haliaeetus leucocephalus	G4/S3B/S5N	USFWS ESA Threatened (T, AD), WGFD CWCS, WGFD NSS2	Wooded areas usually along rivers, lakes, reservoirs. Sometimes in open country
Ferruginous hawk*	**Buteo regalis**	**G4/S4B/S5N**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3**	**Open grasslands and shrublands**
Golden eagle*	**Aquila chrysaetos**	**G5/S3B**		**Open grasslands and shrublands esp. around cliffs and canyons**
Merlin	Falco columbarius	G5/S4	WGFD CWCS, WGFD NSS3	Open woodlands, grasslands, and shrublands sometimes in cities in winter
Greater sage grouse*	**Centrocercus urophasianus**	**G4/S4**	**USFWS ESA Petitioned, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2**	**Sagebrush basins and foothills, generally close to water**
Sandhill crane	**Grus canadensis**	**G5/S3B/S5N**	**WGFD CWCS, WGFD NSS3**	**Meadows, marshes, shorelines, and grain fields**
Mountain plover	**Charadrius montanus**	**G2/S2**	**USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sparse shortgrass or mixed grass prairie. Also in short-sagebrush plains. Often associated with prairie dog towns.**
American avocet	Recurvirostra americana	G5/S3B		Marshes, ponds, and shores, esp. alkaline areas
Long-billed curlew	Numenius americanus	G5/S3B	WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Meadows, pastures, shorelines, and marshes
Black tern (Breeding colonies)	Chlidonias niger	G4/S1	S-USFS R2, WGFD CWCS, WGFD NSS3	Ponds, lakes, reservoirs, and marshes
Yellow-billed cuckoo	Coccyzus americanus	G5/S1	USFWS ESA Candidate (C), WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Deciduous woods and thickets, usually along large streams
Short-eared owl*	**Asio flammeus**	**G5/S2**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Open grasslands, meadows, marshes, and farmland, especially around tall grass or weeds**
Eastern screech owl	Otus asio	G5/S3		Wooded river and stream bottoms, usually with cottonwoods
Burrowing owl*	**Athene cunicularia**	**G4/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Plains and basins, often associated with prairie dog towns**
Chimney swift	Chaetura pelagica	G5/S3B		Cities and towns, usually over buildings
Williamson's sapsucker	Sphyrapicus thyroideus	G5/S2		Old-growth conifer forest, especially a mixture of spruce and lodgepole pine
Loggerhead shrike*	**Lanius ludovicianus**	**G4/S3**	**WY BLM SSL, S-USFS R2**	**Open country with scattered trees and shrubs**
Canyon wren	Catherpes mexicanus	G5/S2S3		Rocky canyons and cliffs
American dipper	Cinclus mexicanus	G5/S4		Fast flowing rocky streams mostly in mountains, moves to lower elev. streams and rivers in winter
Sage thrasher*	**Oreoscoptes montanus**	**G5/S5**	**WY BLM SSL, WGFD CWCS, WGFD NSS4**	**Tall sagebrush and greasewood**
Sage sparrow	**Amphispiza belli**	**G5/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Medium to tall sagebrush shrubland**
Baird's sparrow	Ammodramus bairdii	G4/S1B?/SZN	WY BLM SSL, WGFD NSS4	"Mid-grass" prairie and meadows
Grasshopper sparrow*	**Ammodramus savannarum**	**G5/S4**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**"Mid-grass" prairie, tall-grass prairie, hay meadows, and open savanna.**
Clay-colored sparrow*	**Spizella pallida**	**G5/S3B**		**Brushy riparian areas and brushy woodland edges**

Bold = Documented in our Biotics database. * = Documented request area.

Brewer's sparrow*	**Spizella breweri**	**G5/S5**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sagebrush foothills and medium-height sagebrush in basins. Also, mountain mahogany hills.**
McCown's longspur*	**Calcarius mccownii**	**G5/S2**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sparsely vegetated shortgrass prairie**
Chestnut-collared longspur*	**Calcarius ornatus**	**G5/S1**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Medium height grass, especially meadows around ponds**

Sensitive MAMMALS Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Dwarf shrew*	**Sorex nanus**	**G4/S4**	**WGFD CWCS, WGFD NSS3**	**Historically, found in alpine rubble slopes and conifer forests above 4,000 m. Sometimes found in prairie and pinyon-juniper at lower elevations.**
Long-legged myotis	Myotis volans	G5/S3	WGFD CWCS, WGFD NSS2	Found in conifer and deciduous forests. Roosts include tree and rock crevices, snages and buildings.
Long-eared myotis	Myotis evotis	G5/S4	WY BLM SSL, WGFD CWCS, WGFD NSS2	Found in conifer forests, especially ponderosa pine. Forage over water holes and possible openings in conifer forest. Roosts: caves, buildings, mines.
Silver-haired bat	Lasionycteris noctivagans	G5/S3	WGFD CWCS, WGFD NSS4	Occur in a wide variety of habitats across Wyoming. Roosts: trees, caves, mines, houses
Hoary bat*	**Lasiurus cinereus**	**G5/S4**	**WGFD CWCS, WGFD NSS4**	**Widespread and mobile, hoary bats are found in shrublands, grasslands, and aspen-pine forests near roosting habitat. Roosts: deciduous trees.**
Townsend's big-eared bat	Corynorhinus townsendii	G4/S2	WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS2	Hibernates and day-roosts in caves and mines and will use buildings as day roosts. Typical habitat includes desert shrublands, pinyon-juniper woodlands, and dry conifer forests, generally near riparian or wetland areas.
Wyoming ground squirrel	Spermophilus elegans	G5/S3S4	WGFD CWCS, WGFD NSS6	Found in open habitats from sage grasslands to alpine meadows.
Black-tailed prairie dog	Cynomys ludovicianus	G4/S2	USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS3	Shortgrass prairie, usually with loose, sandy soils. Can form large, dense colonies.
Olive-backed pocket mouse	Perognathus fasciatus	G5/S4	WGFD CWCS, WGFD NSS3	Dry habitats ranging from gravelly soils to sandy areas of short grass prairies to sand dunes.
Swift fox*	**Vulpes velox**	**G3/S2**	**USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Swift foxes occupy shortgrass prairie, but can be found in sage-grasslands. They are particularly found in sparely vegetated areas such as prairie dog towns.**
RED FOX	Vulpes vulpes	G?/T1Q/S1		Red fox are found in intermixed communities of brush, streamsides, pastures, farmlands, and other open areas.
Common gray fox	Urocyon cinereoargenteus	G5/S2		Gray fox are usually found in deciduous forests, riparian areas, and shrubland in hilly country.
Black-footed ferret	**Mustela nigripes**	**G1/S1**	**USFWS ESA Endangered (E, EXPN), WGFD CWCS, WGFD NSS1**	**Black-footed ferrets always occur in or near prairie dog colonies, generally on short or mixed-grass prairie.**

Bold = Documented in our Biotics database. * = Documented request area.

Plains (eastern) spotted skunk	Spilogale putorius interrupta	G5/T4/S3		Usually occur near riparian areas, but also found near human settlements (fence rows, barns, brush piles, etc.).

Sensitive HERPTILES Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Tiger salamander*	**Ambystoma tigrinum**	**G5/S4**	**WGFD CWCS, WGFD NSS4**	**Tiger salamanders can be found in fairly moist environments ranging from rodent burrows to window wells to burrows in sand dunes. Larvae found in intermittent streams, ponds, and lakes.**
Great plains toad	Bufo cognatus	G5/S3	WGFD CWCS, WGFD NSS4	Great Plains toads can be found in grassland communities near ponds and lakes.
Northern leopard frog*	**Rana pipiens**	**G5/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Found near permanent water in areas up to about 9,000 feet. Lower elevation sites are usually swampy cattail marshes and higher ones tend to be beaver ponds.**
Milk snake	Lampropeltis triangulum	G5/S3	WGFD CWCS, WGFD NSS2	Milk snakes can be found in woodlands along escarpments in prairie communities below about 6,000 feet.
Eastern yellowbelly racer	Coluber constrictor flaviventris	G5/T5/S4	WGFD CWCS, WGFD NSS4	The eastern yellow belly racer is found in woodland communities in the plains and foothills zones, usually in the vicinity of water.

Sensitive FISH Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Goldeye	Hiodon alosoides	G5/S2	WGFD CWCS, WGFD NSS2	Goldeye are found in large, often turbid rivers, as well as backwaters, marshes, and shallows in larger lakes and reservoirs. In Wyoming they occur in the Powder, Little Powder, and Missouri Rivers, as well as Clear Creek and Crazy Woman Creek.
Western silvery minnow	Hybognathus argyritis	G4/S2	WGFD CWCS, WGFD NSS1	The western silvery minnow generally inhabits larger rivers, perhaps slow-flowing and silty bottomed. In Wyoming it seems to occur in the Powder and Little Missouri River drainages, and has likely been extirpated from the Big Horn River by construction.
Finescale dace	Phoxinus neogaeus	G5/S2	S-USFS R2, WGFD CWCS, WGFD NSS1	Finescale dace live in "cool, weedy, small streams, ponds and small lakes". It is common in more northern reaches of the country, but in Wyoming has been found in the Niobrara River (near Nebraska) and in various places in Crook County.
Yellowstone cutthroat trout (Native populations)	Oncorhynchus clarki bouvieri	G4/T2/S2	USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Historically Yellowstone cutthroat trout lived in lakes, rivers and streams of the Yellowstone River drainage (including Yellowstone Lake). Also found in the Snake, Tongue, Bighorn, and Clarks Fork Drainages.

SHAPEFILE	AREA	ELEM_TYPE	ELCODE	SNAME
source_pt	Request	Amphibian	AAAAA01140	Ambystoma tigrinum
source_pt	Buffer	Amphibian	AAABH01170	Rana pipiens
source_pt	Request	Amphibian	AAABH01170	Rana pipiens
eorep	Buffer	Bird	ABNKC19120	Buteo regalis
source_line	Buffer	Bird	ABNKC19120	Buteo regalis
source_line	Request	Bird	ABNKC19120	Buteo regalis
source_line	Buffer	Bird	ABNKC22010	Aquila chrysaetos
source_line	Request	Bird	ABNKC22010	Aquila chrysaetos
source_pt	Buffer	Bird	ABNLC12010	Centrocercus urophasianus
source_line	Request	Bird	ABNLC12010	Centrocercus urophasianus
source_line	Buffer	Bird	ABNMK01010	Grus canadensis
data_sensitive	Buffer	Bird	ABNNB03100	Charadrius montanus
source_pt	Buffer	Bird	ABNNB03100	Charadrius montanus
source_pt	Buffer	Bird	ABNSB10010	Athene cunicularia
source_line	Request	Bird	ABNSB10010	Athene cunicularia
source_pt	Request	Bird	ABNSB10010	Athene cunicularia
source_line	Buffer	Bird	ABNSB13040	Asio flammeus
source_pt	Buffer	Bird	ABNSB13040	Asio flammeus
source_pt	Request	Bird	ABNSB13040	Asio flammeus
source_line	Buffer	Bird	ABPBK04010	Oreoscoptes montanus
source_pt	Buffer	Bird	ABPBK04010	Oreoscoptes montanus
source_line	Request	Bird	ABPBK04010	Oreoscoptes montanus
source_pt	Request	Bird	ABPBK04010	Oreoscoptes montanus
source_line	Buffer	Bird	ABPBR01030	Lanius ludovicianus
source_pt	Buffer	Bird	ABPBR01030	Lanius ludovicianus
source_line	Request	Bird	ABPBR01030	Lanius ludovicianus
source_line	Request	Bird	ABPBX94030	Spizella pallida
source_line	Buffer	Bird	ABPBX94040	Spizella breweri
source_pt	Buffer	Bird	ABPBX94040	Spizella breweri
source_line	Request	Bird	ABPBX94040	Spizella breweri
source_pt	Request	Bird	ABPBX94040	Spizella breweri
source_line	Buffer	Bird	ABPBX97020	Amphispiza belli
source_line	Buffer	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Buffer	Bird	ABPBXA0020	Ammodramus savannarum
source_line	Request	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Request	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Buffer	Bird	ABPBXA6010	Calcarius mccownii
source_line	Request	Bird	ABPBXA6010	Calcarius mccownii
source_pt	Request	Bird	ABPBXA6010	Calcarius mccownii
source_pt	Buffer	Bird	ABPBXA6040	Calcarius ornatus
source_line	Request	Bird	ABPBXA6040	Calcarius ornatus
source_pt	Request	Bird	ABPBXA6040	Calcarius ornatus
eorep	Request	Mammal	AMABA01130	Sorex nanus
source_pt	Request	Mammal	AMABA01130	Sorex nanus
eorep	Request	Mammal	AMACC05030	Lasiurus cinereus
source_pt	Request	Mammal	AMACC05030	Lasiurus cinereus
source_pt	Buffer	Mammal	AMAJA03030	Vulpes velox
data_sensitive	Request	Mammal	AMAJA03030	Vulpes velox
source_pt	Request	Mammal	AMAJA03030	Vulpes velox
source_pt	Buffer	Mammal	AMAJF02040	Mustela nigripes
eorep	Buffer	Flowering Plant	PDFAB0F150	Astragalus barrii

source_pt Buffer Flowering Plant PDFAB0F150 Astragalus barrii

COMNAME	G_RANK	S_RANK	USFWS_ESA
Tiger salamander	G5	S4	
Northern leopard frog	G5	S3	
Northern leopard frog	G5	S3	
Ferruginous hawk	G4	S4B,S5N	
Ferruginous hawk	G4	S4B,S5N	
Ferruginous hawk	G4	S4B,S5N	
Golden eagle	G5	S3B	
Golden eagle	G5	S3B	
Greater sage grouse	G4	S4	Petitioned
Greater sage grouse	G4	S4	Petitioned
Sandhill crane	G5	S3B,S5N	
Mountain plover	G2	S2	Listing Denied
Mountain plover	G2	S2	Listing Denied
Burrowing owl	G4	S3	
Burrowing owl	G4	S3	
Burrowing owl	G4	S3	
Short-eared owl	G5	S2	
Short-eared owl	G5	S2	
Short-eared owl	G5	S2	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Loggerhead shrike	G4	S3	
Loggerhead shrike	G4	S3	
Loggerhead shrike	G4	S3	
Clay-colored sparrow	G5	S3B	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Sage sparrow	G5	S3	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
McCown's longspur	G4	S2	
McCown's longspur	G4	S2	
McCown's longspur	G4	S2	
Chestnut-collared longspur	G5	S1	
Chestnut-collared longspur	G5	S1	
Chestnut-collared longspur	G5	S1	
Dwarf shrew	G4	S4	
Dwarf shrew	G4	S4	
Hoary bat	G5	S4	
Hoary bat	G5	S4	
Swift fox	G3	S2	Listing Denied
Swift fox	G3	S2	Listing Denied
Swift fox	G3	S2	Listing Denied
Black-footed ferret	G1	S1	Endangered (E, EXPN)
Barr's Milkvetch	G3	S3	

Barr's Milkvetch	G3	S3

AGENCYSTAT	TRACKSTAT
WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
	W
	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Y
WGFD CWCS, WGFD NSS3	W
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2	Y
WY BLM SSL, S-USFS R2	Y
WY BLM SSL, S-USFS R2	Y
	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WGFD CWCS, WGFD NSS3	W
WGFD CWCS, WGFD NSS3	W
WGFD CWCS, WGFD NSS4	W
WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WGFD CWCS, WGFD NSS1	Y
S-USFS R2	Y

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D-03

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D-04

APPENDIX D9:

WILDLIFE

November 2007

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LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF EXHIBITS

LIST OF ABBREVIATIONS AND ACRONYMS

BFF	Black-footed ferret
BLM	Bureau of Land Management
ISR	In Situ Recovery
MBHFI	Migratory Birds of High Federal Interest
NRCS	Natural Resources Conservation Service
SS	Special status
TEPC	Threatened, endangered, proposed, and candidate
TRC	TRC Environmental Corporation
USFWS	U.S. Fish and Wildlife Service
WDEQ/LQD	Wyoming Department of Environmental Quality, Land Quality Division
WGFD	Wyoming Game and Fish Department
WNDD	Wyoming Natural Diversity Database

D9.1.0 INTRODUCTION

D9.1.1 HABITAT DESCRIPTION AND BACKGROUND INFORMATION

The project area is within the 10- to 14-inch Northern Plains (10-14NP) zone of northeastern Wyoming (Natural Resources Conservation Service [NRCS] 1988). The study area has the potential to provide habitat for mule deer, elk, pronghorn antelope, jackrabbit, cottontail rabbit, coyote, bobcat, mountain lion, red fox, badger, raccoon, skunk, chipmunk, rodents, songbirds, waterfowl, eagles, hawks, owls, sage grouse, chukar, wild turkey, gray partridge, mourning dove, magpie, and crow. Most species are yearlong residents; however, some species such as elk, eagles, songbirds, and waterfowl are more abundant during migration periods (Cerovski et al. 2004).

Several federal threatened, endangered, proposed, and candidate (TEPC) species have been identified by the U.S. Fish and Wildlife Service (USFWS) to have the potential to occur within or in the vicinity of the Nichols Ranch ISR Project area: black-footed ferret (endangered), bald eagle (threatened), and Ute ladies'-tresses orchid (threatened) (refer to Addendum D9A). In addition, the Bureau of Land Management (BLM), Buffalo Field Office also monitors and manages nonlisted species (i.e., species of concern) that could occur on federal lands to reduce potential impacts that might lead to their listing by the USFWS. The BLM has developed a list of special status (SS) species for the BLM Buffalo Field Office area. These SS species are listed in Section D9.2.11.

To comply with Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) *Noncoal Rules and Regulations* (2000) and *Guideline No. 5* (1987), TRC Environmental Corporation (TRC) of Laramie, Wyoming, and Wildlife Resources of Buffalo, Wyoming, completed baseline wildlife inventories on the Nichols Ranch ISR Project area in 2006-2007. Data collection needs and procedures used in the preparation of this section of the permit were based on recommendations set forth in WDEQ/LQD *Guideline No. 5* (1987). The level of baseline wildlife inventories was modified from WDEQ/LQD *Guideline No. 5* (1987) to better reflect the project and site-specific circumstances of the proposed mine.

The baseline wildlife inventories included a big game winter survey, greater sage-grouse lek monitoring, raptor nest activity and productivity surveys, prairie dog colony mapping, TEPC species (bald eagle winter roost and nesting surveys), surveys for sensitive species or their habitat, and incidental wildlife observations (big game, birds, lagomorphs, small mammals, reptiles, and amphibians).

D9.1.2 DESCRIPTION OF SAMPLING AREA

D9.1.2.1 Location and Size

The Nichols Ranch ISR Project area is located in Campbell and Johnson Counties, Wyoming, and encompasses two production units--the Hank Unit and the Nichols Ranch Unit. The total project area encompasses approximately 3,750.53 acres in portions of Sections 7, 8, 17, 18, and 20, T43N, R76W, and Sections 30 and 31, T44N, R75W, and Sections 5, 6, 7 and 8, T43N, R75W. Access is by way of the Van Buggenum Road west from Wyoming Highway 50. The wildlife study area includes the project area and a 2-mi buffer (see Exhibits D9-1 through D9-4). The entire wildlife survey area (project area plus the 2.0-mi survey area) encompasses approximately 62.0 mi^2 (39,659.6 acres).

D9.1.2.2 Topography

Topographic relief ranges from 5,055 to 5,209 ft above mean sea level in the Hank Unit and from 4,670 to 4,900 ft above mean sea level in the Nichols Ranch Unit. Annual precipitation varies from 10 to 14 inches, with approximately 35-41% falling during the normal growing season (NRCS 1988). Growth of native cool-season plants begins about April 1 and continues until about July 1. Growth of native warm-season plants begins about May 15 and continues until about August 15.

D9.1.2.3 Habitat and Vegetative Composition

The wildlife study area lies entirely within the Powder River drainage basin. Cottonwood Creek, an ephemeral stream, is the main drainage in the Nichols Ranch Unit. Several springs with adjacent wetlands are located in the Cottonwood Creek drainage in the southeast corner of the Nichols Ranch Unit. Within the project area, Cottonwood Creek has been physically altered by local ranches, and a system of irrigation ditches has been constructed to supply water to the area for hay production; therefore, there is no defined bed/bank with a typical pool-riffle riverine system in the project area. Two ephemeral streams--Dry Willow Creek and Willow Creek--are the main drainages of the Hank Unit. Current land use in the project area is primarily livestock grazing, wildlife habitat, and coalbed methane and natural gas development.

Vegetation communities (i.e., wildlife habitat types) that occur in the project area are illustrated on Exhibit D8-1 and descriptions of each community are presented in detail in Appendix D8. A detailed description of the wetland community is presented in Appendix D10.

Vegetation communities present within the project and wildlife survey area and their equivalent Wyoming Game and Fish Department (WGFD) classifications (Cerovski et al. 2004) are:

- sagebrush shrubland (4.12),
- mixed grassland (4.10),
- juniper outcrop (4.7),
- bottomland (2.30),
- disturbed land (99.8),
- greasewood shrubland (4.20),
- wetlands (8.20), and
- rock outcrop (12.40).

D9.2.0 SAMPLING METHODS AND RESULTS AND DISCUSSION

D9.2.1 INTRODUCTION

Field surveys were conducted within the Nichols Ranch ISR Project area and extended survey areas during April, May, June, and July 2006 and February 2007. A list of wildlife species observed within the wildlife survey area was complied over the course of the 2006-2007 survey period. Wildlife species that were not observed but that have the potential to occur in the survey area were determined from published literature, the Wyoming Natural Diversity Database (WNDD) (2006), and the *Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming* (Cerovski et al. 2004). A list of actual and potential species is presented in Addendum D9B.

D9.2.2 BIG GAME

D9.2.2.1 Survey Methods and Results

Opportunistic surveys of big game species were conducted in conjunction with other wildlife surveys (i.e., greater sage-grouse leks and raptor nest surveys) and vegetation sampling tasks throughout the 2006-2007 field season. One formal big game winter survey was conducted on February 15, 2007, by two Wildlife Resources biologists. The survey included the project area plus the extended wildlife survey area (refer to Exhibits D9-1 and D9-2). Surveys were performed by biologists in 4WD vehicles along an 88.2-mi route (refer to Exhibits D9-1 and D9-2). Frequent stops were made to search surrounding areas with binoculars for big game animals. A spotting scope was used to facilitate the determination of sex and age of animals observed. Group size, sex, age composition (e.g., yearling, fawn, adult), and vegetation community for each observation were recorded. The big game winter survey followed procedures outlined in WDEQ/LQD *Guideline No. 5* (1987) and the *Handbook of Biological Techniques* (WGFD 1982).

D9.2.2.2 Results and Discussion

Two species of big game--pronghorn antelope and mule deer--were observed in the wildlife survey area throughout the 2006-2007 field season. Pronghorn were mainly associated with the mixed grassland and sagebrush shrubland vegetation types. Mule deer were generally observed in mixed sagebrush grassland and juniper outcrop vegetation types.

D9.2.2.2.1 Pronghorn

The Nichols Ranch ISR Project wildlife survey area is within the Pumpkin Buttes Antelope Herd Unit and Hunt Area 23 (WGFD 2005a). The Pumpkin Buttes Antelope Herd Unit occupies 1,544 mi^2, of which 1,475 mi^2 are considered occupied antelope habitat (WGFD 2005b). The Pumpkin Buttes Antelope Herd Unit has been above objective population size since 1999. The current population objective is 18,000 animals (WGFD 2005a). The 2002 to 2004 population estimates of the herd unit averaged 25,383 animals. The 2005 population estimate was 32,405 animals. Based on the current population trends, harvest numbers, and hunter success numbers, the projected 2006 post-season population estimate for the Pumpkin Buttes Antelope herd is 36,560 animals (WGFD 2005a). With most of the herd unit under private ownership, hunter access and harvest rates is governed by private land owners, making achieving adequate harvest the largest issue affecting the management of this herd unit (WGFD 2005a).

The entire wildlife survey area lies within habitat designated by the WGFD as winter/yearlong and yearlong range for pronghorn (refer to Exhibit D9-1). There are no crucial pronghorn ranges within the wildlife survey area. The nearest crucial range for pronghorn occurs approximately 39 mi south of the project area (WGFD 2005b).

In spring and summer, pronghorn antelope were observed primarily in the mixed grassland and open areas within the sagebrush shrubland community. Twin fawns were commonly observed with does throughout the wildlife study area in June and July.

Based on the winter survey observations, the buck:doe ratio is calculated as 74 bucks per 100 does and 48 fawns per 100 does (Wildlife Resources 2007). During the 2007 winter big game surveys, pronghorn antelope were primarily observed within the sagebrush shrubland and mixed grassland vegetation communities. A total of 460 pronghorn antelope were observed in the wildlife survey area--153 males, 208 females, and 99 fawns (refer to Table D9-1).

D9.2.2.2.2 Mule Deer

The Nichols Ranch ISR Project wildlife survey area is within portions of the Pumpkin Buttes Mule Deer Herd Unit. The Pumpkin Buttes Mule Deer Herd is comprised of Hunt Areas 19, 20, 29, and 31. The herd unit contains 2,706 mi^2 of occupied habitat. The current population objective is 11,000 animals. The 2002 to 2004 population estimates of the herd unit averaged 12,589 animals. The 2005 population estimate was 10,350 animals. Based on the current population trends, harvest numbers, and hunter success number, the projected 2006 post-season population estimate for the Pumpkin Buttes Antelope herd is 9,990 animals (WGFD 2005a).

The project area and wildlife study area lies within habitat designated as winter/yearlong and yearlong range (refer to Exhibit D9-2). There are no crucial mule deer ranges within the wildlife survey area. The nearest mule deer crucial winter range occurs approximately 39 mi west of the project area (WGFD 2005b).

In spring and summer, mule deer were throughout the project area with no affinity to a particular vegetation community. However, the largest of the buck mule deer were generally observed in the juniper outcrop.

During the winter surveys, mule deer distribution was generally concentrated in the sagebrush shrubland and grassland habitats. A total of 322 mule deer were observed in the wildlife survey area (Table D9-2)--58 males, 176 females, and 88 fawns. Based on the winter survey observations, the buck:doe ratio is calculated as 33 bucks per 100 does and 50 fawns per 100 does.

Table D9-1 Pronghorn Antelope Observations, Winter Big Game Survey, Hank and Nichols Units, 2007.

	Buck	Doe	Fawn	Legal Description	Habitat Type
	45	51	30	Section 9, T43, R75	Sagebrush
	20	25	13	Section 2, T43, R76	Sagebrush/Grassland
	2	10	1	Section 2, T43, R76	Sagebrush/Grassland
	5	7	3	Section 6, T43, R75	Sagebrush
	4	5	1	Section 20, T44, R75	Sagebrush/Grassland
	9	13	8	Section 30, T44, R75	Sagebrush/Grassland
	7	6	2	Section 24, T44, R76	Sagebrush/Grassland
	6	9	3	Section 24, T44, R76	Sagebrush/Grassland
	7	21	6	Section 13, T44, R76	Grassland
	4	7	3	Section 21, T44, R75	Sagebrush
	9	7	6	Section 27, T43, R76	Sagebrush/Grassland
	1	0	0	Section 4, T43, R76	Sagebrush
	2	0	0	Section 11, T43, R76	Sagebrush
	8	14	7	Section 15, T43, R76	Sagebrush/Grassland
	3	8	0	Section 28, T43, R76	Sagebrush/Grassland
	3	1	0	Section 20, T43, R76	Sagebrush/Grassland
	1	0	0	Section 13, T43, R77	Sagebrush/Grassland
	0	0	1	Section 1, T43, R77	Sagebrush
	1	0	0	Section 6, T43, R76	Sagebrush/Grassland
	16	24	15	Section 24, T43, R77	Sagebrush/Grassland
Subtotal	153	208	99		
Total Antelope		460			

Table D9-2 Mule Deer Observations, Winter Big Game Survey, Hank and Nichols Ranch Units, 2007.

	Buck	Doe	Fawn	Legal Description	Habitat Type
	0	5	5	Section 33, T44, R75	Sagebrush
	10	10	10	Section 9, T43, R75	Sagebrush/Grassland
	0	7	6	Section 16, T43, R75	Sagebrush
	4	0	0	Section 17, T43, R75	Sagebrush
	0	5	1	Section 17, T43, R75	Sagebrush
	7	18	11	Section 8, T43, R75	Sagebrush
	0	5	5	Section 12, T43, R76	Sagebrush
	3	2	3	Section 3, T43, R76	Sagebrush/Grassland
	3	3	3	Section 36, T44, R76	Sagebrush
	2	8	3	Section 6, T43, R75	Sagebrush
	1	2	1	Section 30, T44, R75	Sagebrush
	0	5	0	Section 25, T44, R75	Sagebrush
	2	0	0	Section 20, T44, R75	Sagebrush
	4	15	7	Section 25, T44, R76	Sagebrush
	0	2	2	Section 21, T44, R75	Sagebrush
	2	2	2	Section 22, T43, R76	Sagebrush
	0	3	1	Section 23, T43, R76	Sagebrush/Grassland
	0	2	4	Section 23, T43, R76	Sagebrush/Grassland
	4	8	2	Section 11, T43, R76	Sagebrush/Grassland
	1	4	1	Section 3, T43, R76	Sagebrush/Grassland
	0	2	1	Section 3, T43, R76	Sagebrush/Grassland
	1	11	1	Section 3, T43, R76	Sagebrush/Grassland
	2	0	0	Section 3, T43, R76	Sagebrush/Grassland
	7	0	0	Section 4, T43, R76	Sagebrush/Grassland
	0	9	3	Section 22, T43, R76	Riparian/Grassland
	0	8	0	Section 21, T43, R76	Riparian
	0	5	5	Section 21, T43, R76	Riparian
	0	3	1	Section 30, T43, R76	Riparian
	1	12	3	Section 9, T43, R76	Grassland
	0	4	1	Section 5, T43, R76	Sagebrush
	3	0	0	Section 7, T43, R76	Sagebrush
	0	3	1	Section 13, T43, R77	Sagebrush/Grassland
	1	3	2	Section 24, T43, R77	Sagebrush/Grassland
	0	10	3	Section 24, T43, R77	Sagebrush/Grassland
Subtotal	58	176	88		
Total Mule Deer		322			

D9.2.3 UPLAND GAME BIRDS

D9.2.3.1 Survey Methods

The locations of known greater sage-grouse leks within 2.0 mi of the production units were gathered from the BLM Buffalo Field Office (which incorporates both BLM and WGFD lek data). Formal surveys on greater sage-grouse lek activity were conducted in April 2006 within the wildlife study area. Each lek was visited three times at sunrise and the maximum number of males and female birds were recorded.

No other formal surveys were conducted for upland bird species.

D9.2.3.2 Results and Discussion

Two species of upland game birds were sighted on the wildlife survey area during the 2006-2007 field season--greater sage-grouse and gray partridge.

Ten greater sage-grouse leks occur within the wildlife study area (refer to Exhibit D9-3). Based on the information gathered from the BLM database, eight are known to occur within 2.0 mi of the project area. Two new satellite leks were discovered in 2006--North Butte Satellite and Dry Willow Satellite. All of the 10 leks were active in 2006. The North Butte and Dry Willow leks had the greater number of birds observed, ranging from 55 to 70+ males. The results of the 2006 surveys and historic lek activity data are presented in Table D9-3.

Several female sage grouse with young were observed in the Dry Willow drainage just north of the Hank Unit in July. No greater sage-grouse were observed during the February winter survey.

Table D9-3 2006 Survey and Historic Greater Sage-grouse Lek Activity, Uranerz Wildlife Study Area.

		Maximum Number[1]	
Lek ID	Year	Males	Females
38-Windmill NW	2001	12	2
	2002	18	--
	2003	15	--
	2004	7	3
	2005	0	0
	2006	1	0
Windmill	2006	1	1
38-North Butte	1981	3	0
	1982	Not Checked	--
	1983	Not Checked	--
	1984	Not Checked	--
	1985	Not Checked	--
	1986	0	--
	1987	Not Checked	--
	1988	4	--
	1989	Not Checked	--
	1990	0	--
	1991	Not Checked	--
	1992	14	--
	1993	10	--
	1994	Not Checked	--
	1995	25	--
	1996	15	--
	1997	20	--
	1998	Not Checked	--
	1999	0	--
	2000	0	0
	2001	No Data Available	--
	2002	12	--
	2003	10	5
	2004	0	0
	2005	44	0
	2006	60+	0
North Butte Satellite	2006	7	0
38-Mud Spring Creek	2004	14	4
	2005	21	2
	2006	16	4

Table D9-3 (Continued)

Lek ID	Year	Maximum Number[1]	
		Males	Females
38-Gilbertz III	1979	18	9
	1980	42	0
	1980	46	0
	1981	39	28
	1982	Not Checked	--
	1983	Not Checked	--
	1984	17	--
	1985	8	11
	1986	9	0
	1987	Not Checked	--
	1988	Not Checked	--
	1989	0	--
	1990	Not Checked	--
	1991	Not Checked	--
	1992	0	--
	1993	Not Checked	--
	1994	Not Checked	--
	1995	0	--
	1996	0	--
	1997	0	--
	1998	Not Checked	--
	1999	0	--
	2000	0	0
	2001	--	--
	2002	0	0
	2003	0	0
	2004	0	1
	2005	0	0
	2006	10	0
38-Dry Willow	2005	23	0
	2006	70+	0
Dry Willow Satellite	2006	25+	0
PC1/Cottonwood	2006	25	1
Hines Satellite	2006	11	0

[1] Maximum number of males and females may not have been observed during the same lek visit; -- = no data available.

D9.2.4 WATERFOWL AND SHOREBIRDS

D9.2.4.1 Survey Methods

Limited habitat for waterfowl and shorebirds occurs in the project area; therefore, formal surveys for waterfowl and shorebirds were not conducted. However, throughout the course of the 2006 field surveys, incidental sightings of waterfowl and shorebirds on or adjacent to the project area were recorded.

D9.2.4.2 Results and Discussion

One small pond located in the Nichols Ranch Unit is the only perennial source of water within the project area to provide potential waterfowl habitat. Other seasonal water sources that provide suitable waterfowl and shorebird habitat include constructed stockponds scattered throughout the wildlife study area.

The actual use of the project area by waterfowl and shorebirds throughout the year was relatively low due to the small size and low quality of wetlands present in the project area. One mallard duck was observed on the pond in the Nichols Ranch Unit in July. Waterfowl and shorebird species expected to occur within the general region of the survey area are listed in Addendum D9B .

D9.2.5 MAMMALIAN PREDATORS

D9.2.5.1 Sampling Methods

Formal surveys for mammalian predators were not conducted. However, occurrences of these species were documented during the course of other fieldwork conducted during 2006-2007.

D9.2.5.2 Results and Discussion

Three species of mammalian predators were observed during field survey work: bobcat, badger, and coyote. In addition, a swift fox was observed approximately 5.0 mi east of the project area crossing the Van Buggenum road. Mammalian predators species expected to occur within the general region of the survey area are listed in Addendum D9B .

D9.2.6 LAGOMORPHS

D9.2.6.1 Sampling Methods

Formal surveys for lagomorphs were not conducted. However, occurrences of these species were documented during the course of other fieldwork conducted during 2006.

D9.2.6.2 Results and Discussion

Numerous sightings of desert cottontail rabbits and white-tailed jackrabbits were documented within the project area and the wildlife survey area during 2006-2007. These sightings occurred in all of the available habitats; however, the highest concentration of rabbits was observed around disturbed areas such as the existing well pads, a compression station, and along existing roads. In addition to observations of live lagomorphs, numerous dead ones, mainly cottontail rabbits, were observed throughout the project area. The majority of the mortalities were noted within the Hank Unit. These observations were reported to the WGFD Gillette Field Office and a biologist from the department collected several of the specimens and sent them to the Wyoming State Lab for analysis. The analyses revealed an outbreak of Tularemia, or rabbit fever, which is an infectious bacterial disease that typically affects rabbits, hares, and rodents.

D9.2.7 SMALL MAMMALS

D9.2.7.1 Sampling Methods

Formal surveys for small mammals were not conducted. However, occurrences of these species were documented during the course of other fieldwork.

D9.2.7.2 Results and Discussion

Thirteen-lined ground squirrel and black-tailed prairie dog were the only species of small mammals observed within the survey area. Approximately 356.5 acres of black-tailed prairie dog colonies occur in the project areas. A total of 941.8 acres of prairie dog colonies occurs within the wildlife study area. Small mammals that have the potential to occur in or near the survey area are listed in Addendum D9B. The locations of black-tailed prairie dog colonies are presented on Exhibit D9-3.

D9.2.8 RAPTORS

D9.2.8.1 Sampling Methods

Raptor nesting activities within the wildlife survey area were monitored throughout the 2006 breeding and nesting season, and incidental sightings of raptors were documented during all other seasonal field activities. A nest was determined to be active if one of the following conditions was observed:

- eggs were laid,
- young were present, or
- an adult was observed in incubating posture on the nest (Postupalsky 1974).

In addition, nests were considered active if adult birds displayed defensive behavior within the vicinity of known or potential nest sites.

An inventory of raptor nests located in the project area was conducted in April and May prior to the appearance of foliage on the trees. Follow-up productivity surveys on occupied nests were conducted in June. The activity status of all nests was documented.

Nests were observed from a distance to avoid disturbing nesting birds. Binoculars and a spotting scope were used to determine the presence and, if possible, the number of young in the nest. Nests that could not be properly observed were classified as active if at least one adult was observed defending the nest. If no sign of occupancy was evident, the area below and around the nest was checked for signs of recent activity (mutes, pellets, feathers, prey remains, or young) in an attempt to verify, or determine the cause of, nest failure.

Winter occurrences of raptors within the wildlife survey area were recorded during the winter big game and bald eagle winter roost surveys, which occurred in January and February 2007.

D9.2.8.2 Results and Discussion

A total of five raptor species was observed nesting within the survey area during the 2006 field season. These included red-tailed hawk, golden eagle, prairie falcon, long-eared owl, and great horned owl. The locations and activity status of raptor nests are provided in Table D9-4 and illustrated on Exhibit D9-3. Raptor species that have the potential to occur in or near the survey area are listed in Addendum D9B.

During the 2006 field season, 40 raptor nests were found within the project area (refer to Exhibit D9-3), of which 10 were determined to be active. Nine of the 10 active nests are located in the Hank Unit and one of the active nests is located in the Nichols Ranch Unit. Nine active nests were observed in the Hank Unit: three red-tailed hawk, three long-eared owl, and three great horned owl. The red-tailed hawks nests were located in isolated cottonwood trees in drainages. The long-eared owls utilized junipers for nesting. The great horned owl nest was located in a cliff/bank of an incised drainage. An active golden eagle nest was observed in a cottonwood tree in the Nichols Ranch Unit. Of the 10 nests determined to be active, it could be

Table D9-4 Locations and Activity Status of Raptor Nests During the 2006 Nesting Season.

Map ID Number	UNIT	I.D.[1]	Legal Location			County	Date	Status[2]	Condition	Subtrate[3]/ Height (ft)	Nest/ Height (ft)	Elevation (ft)	Nest Aspect	Eggs/ Young	Comments
			Township	Range	Section										
1	Hank Unit	RTHA4 4763601	44	75	36, NE NE	Campbell	4/28/06	ACTI	Good	CTL/50	Sticks/40	5,150			No adults or young at nest 6/29/06
2	Hank Unit	UK4375 701	43	75	7, NW/ NW	Campbell	5/5/06	INAC	Fair	CTL/40	Sticks/35	4,997	SE		
3	Hank Unit	UK4375 702	43	75	7 NW NW	Campbell	5/5/06	INAC	Fair	CTL/40	Sticks/35	5,032	South		
4	Hank Unit	UK4376 101	43	76	1, NW/ SE	Campbell	5/5/06	INDI	Poor	JUL/12	Sticks/7	4,988	NW		New for '06
5	Hank Unit	LEOW4 376101	43	76	1, NE/ NE	Campbell	5/5/06	ACTI	Fair	JUL/18	Sticks/12	5,029	South		Possibly fledged by 6/29/06; new for '06, LEOW at nest
6	Hank Unit	LEOW4 376102	43	76	1, NE/ SE	Campbell	5/5/06	ACTI	Fair	JUL/16	Sticks/12	5,041	SW		Possibly fledged by 6/29/06; new for '06, LEOW in nest
7	Hank Unit	GHOW 4375701	43	75	7, NE/ NW	Campbell	5/5/06	ACTI	NA	CLF	NA/18	5,014	South	3 young	Adult flew from hole in cliff, new for '06
8	Hank Unit	PRFA44 753201	44	75	32, SW SW	Campbell	5/17/06	OCCU	Good	ROC					Did not locate exact nest or young 6/26/06
9	Hank Unit	PRFA44 753202	44	75	32, SW SW	Campbell	5/17/06	OCCU	Good	ROC					Did not locate exact nest or young 6/26/06
10	Hank Unit	UK4375 703	43	75	7, NE/ NW	Campbell	5/5/06	INDI	Poor	CTL/45	Sticks/30	5,017	West		
11	Hank Unit	RTHA4 375701	43	75	7, NW/ NE	Campbell	5/5/06	ACTI	Good	CTL/40	Sticks/30	5,086	South	2 young	Two young in nest, 6/29/06; RTHA in nest

Table D9-4 (Continued)

Map ID Number	UNIT	I.D.[1]	Legal Location			County	Date	Status[2]	Condition	Subtrate[3]/ Height (ft)	Nest/ Height (ft)	Elevation (ft)	Nest Aspect	Eggs/ Young	Comments
			Township	Range	Section										
12	Hank Unit	GHOW 4375801	43	75	8, NW/ NW	Campbell	5/5/06	ACTI	NA	CLF	Dirt/20	5,094	North	1 egg/ 1 young	2 GHOW at nest site, new for '06
13	Hank Unit	LEOW4 375701	43	75	7, SE/ NE	Campbell	5/5/06	ACTI	Good	JUL/15	Sticks/10	5,046	East		Possibly fledged by 6/29/06; LEOW in nest, new for '06
14	Hank Unit	UK4375 501	43	75	5, NE/ SW	Campbell	5/17/06	INAC	Fair	JUL/15	Sticks/12	5,268	East		
15	Hank Unit	UK4375 502	43	75	5, NE/ SW	Campbell	5/17/06	INDI	Poor	JUL/15	Sticks/10	5,322	South		
16	Hank Unit	UK4375 503	43	75	5, NE/ SW	Campbell	5/17/06	INDI	Poor	JUL/12	Sticks/8	5,224	Center		
17	Hank Unit	RTHA4 375801	43	75	8, SW/ NW	Campbell	5/5/06	ACTI	Good	CTL/50	Sticks/ 40	5,144	North	1 young	One young in nest, nearly fledged, 6/29/06; RTHA in nest, active in '05
18	Hank Unit	GHOW 4375802	43	75	8, SW/ NW	Campbell	5/5/06	ACTI	Good	CTD/10	Sticks/10	5,140	South		Possibly fledged by 6/29/06; 2 GHOW at nest in hole of dead tree
19	Hank Unit	RTHA4 3761201	43	76	12, SE SW	Campbell	6/8/06	OCCU	Good	CTL/45	Sticks/40				No adults or young at nest, likely was alternate nest 6/29/06
20	Hank Unit	UK4375 1801	43	75	18, NE NW	Campbell	5/5/06	INAC	Good	CTL/35	15				
21	Hank Unit	UK4375 801	43	75	8, NW/ SW	Campbell	5/5/06	INAC	Fair	JUL/14	Sticks/10	5,095	North		New for '06

Table D9-4 (Continued)

Map ID Number	UNIT	I.D.[1]	Legal Location			County	Date	Status[2]	Condition	Subtrate[3]/ Height (ft)	Nest/ Height (ft)	Elevation (ft)	Nest Aspect	Eggs/ Young	Comments
			Township	Range	Section										
22	Hank Unit	UK4375 802	43	75	8, NW/ SW	Campbell	5/5/06	INDI	Poor	CTL/35	Sticks/25	5,122	North		Directly above UK4375803 located in JUL
23	Hank Unit	UK4375 803	43	75	8, NW/ SW	Campbell	5/5/06	INDI	Poor	JUL/18	Sticks/10	5,122	East		Below UK4375802 located in CTL
24	Hank Unit	UK4375 804	43	75	8, NW/ SW	Campbell	5/5/06	INAC	Fair	JUL/15	Sticks/10	5,119	NE		New for '06
25	Hank Unit	UK4375 805	43	75	8, SW/ SW	Campbell	5/5/06	INAC	Fair	WIL/25	Sticks/12	5,122	SE		New for '06
26	Hank Unit	UK4376 1301	43	76	13, NE NE	Campbell	5/17/06	INAC	Fair	CTL/45	Sticks/30				
27	Hank Unit	UK4376 1201	43	76	12, SE SW	Campbell	6/8/06	INAC	Poor	CTL 40	20				
28	Hank Unit	LEOW4 4753001	44	75	30, NE SW	Campbell	6/8/06	INAC	Good	JUL/15	10				
29	Nichols Unit	UK4376 1702	43	76	17, NE/ NW	Johnson	4/22/06	INAC	Fair	CTL/40	Sticks/30		West		
30	Nichols Unit	LEOW4 3761701	43	76	17, NW/ NW	Johnson	4/22/06	INAC	Good	CTL/35	Sticks/20		SW		Not LEOW in 06, may have been alternate RTHA
31	Nichols Unit	UK4376 1701	43	76	17, NW/ NW	Johnson	4/22/06	INAC	Fair	CTL/45	Sticks/30		West		
32	Nichols Unit	UK4376 1901	43	76	19, NE/NE	Johnson	4/22/06	INDI	Poor	CTL/45	Sticks/30		NW		Large branch has fallen into nest
33	Nichols Unit	UK4376 1601	43	76	16, SW/ NW	Campbell	4/22/06	INAC	Fair	CTL/25	Sticks/20		South		
34	Nichols Unit	LEOW4 3761601	43	76	16, SW/ NW	Campbell	4/22/06	OCCU	Fair	CTL/40	Sticks/30		SW		Possibly fledged by 6/29/06

Table D9-4 (Continued)

Map ID Number	UNIT	I.D.[1]	Legal Location: Township	Range	Section	County	Date	Status[2]	Condition	Subtrate[3]/ Height (ft)	Nest/ Height (ft)	Elevation (ft)	Nest Aspect	Eggs/ Young	Comments
35	Nichols Unit	UK4376 1602	43	76	16, SW/ NW	Campbell	4/22/06	INAC	Fair	CTL/25	Sticks/20		South		
36	Nichols Unit	GOEA4 3761701	43	76	17, SW SE	Campbell	5/6/06	GONE	Gone						
37	Nichols Unit	GOEA4 3762001	43	76	20, NE NE	Campbell	5/6/06	INAC	Fair	CLF	Sticks/ Sagebrush				
38	Nichols Unit	GOEA4 3762002	43	76	20, NE NE	Campbell	5/6/06	ACTI	Good	CTL/50	Sticks40			2 young	Two eaglets in nest 6/29/06
39	Nichols Unit	UK4376 1607	43	76	16, SW	Campbell	5/5/06	INAC	Fair	CTL/50	Sticks/30				
40	Nichols Unit	UK4376 1703	43	76	17, SE SE	Campbell	5/5/06	INAC	Fair	CTL/55	Sticks/25	4,700			

[1] **I.D.**
RTHA Red-tailed hawk
LEOW Long-eared owl
GHOW Great horned owl
PRFA Prairie falcon
GOEA Golden eagle
UK Unknown

[2] **Nest Status**
ACTI Active nest = a nest in which a breeding attempt was made as indicated by 1) nests in nest, 2) young in nest, 3) fledged young near nest or 4) incubating/brooding adult.
INAC Inactive nest = a nest with no apparent use or adult presence at the time of the observation, but in good condition.
OCCU Occupied nest = a nest with one of the following: 1) fresh lining material, 2) adult presence at or near nest, or 3) recent and well-used perch site near the nest.
GONE Nest was gone = a nest was located during a previous survey but was found to be destroyed and no longer exists. No evidence remains.
INDI Inactive Dilapidated Nest = an inactive nest in a state of ruin due to weather, natural aging, and/or neglect.

[3] **Substrate**
CTL Cottonwood tree (Live)
CLF Cliff
JUL Juniper tree (Live)
CTD Cottonwood tree (Dead)
WIL Willow (Live)
ROC Rock cavity

confirmed that there were three young red-tailed hawks, four young great horned owls, and two golden eaglets produced in 2006. In the Nichols Ranch Unit, the golden eagle nest had two eaglets in the nest in late June. It is assumed that the nests occupied by long-eared owls in April and May had fledged by the time of the June survey.

The remaining 30 nests were inactive or status unknown and ranged from poor to fair in general condition. The species that either built or previously occupied these nests is unknown.

Raptors observed in the wildlife study area in January and February 2007 included bald eagle, red-tailed hawk, golden eagle, and rough-legged hawk. Refer to Section D9.2.11.2 for a discussion on the results of winter raptor use of the wildlife study area.

D9.2.9 NONGAME/MIGRATORY BIRDS

D9.2.9.1 Survey Methods

No formal surveys for nongame/migratory birds were conducted. Winter occurrence surveys of bird species were conducted in conjunction with the February big game surveys. Incidental sightings of all birds species in the survey area were recorded throughout all other phases of fieldwork performed during the 2006 field season with particular attention given to Migratory Bird Species of Management Concern (i.e., Migratory Birds of High Federal Interest [MBHFI]) in Wyoming. This list is provided in Addendum D9A .

D9.2.9.2 Results and Discussion

The project area may provide potential nesting and foraging for numerous MBHFI bird species. From none to limited habitat is available for wetland/riparian/aquatic obligate bird species; the sagebrush, grasslands, and juniper vegetation dominated communities may provide habitat for species such as lark bunting, Brewer's sparrow, northern shrike, ferruginous hawk, Swainson's hawk, sage sparrow, sage thrasher, and Vesper and lark sparrows. Brewer's sparrow was the only MBHFI bird species recorded during the on-site surveys. Potential habitat for burrowing

owls occurs in the prairie dog colonies. Additional species that have the potential to occur in or near the survey area are listed in Addendum D9B.

D9.2.10 REPTILES AND AMPHIBIANS

D9.2.10.1 Sampling Methods

No formal surveys for reptiles and amphibians were conducted. However, incidental observations of reptiles and amphibians were recorded throughout all phases of wildlife survey work.

D9.2.10.2 Results and Discussion

Two species of reptiles were observed in or adjacent to the project area the during 2006 field surveys--the prairie rattlesnake and bullsnake. Several prairie rattlesnakes ranging from 2 to 3 ft in length were observed in the juniper outcrop community. One rattlesnake of an undetermined length was observed in a hole in the bottomland community in the Nichols Ranch Unit. One bullsnake (approximately 48 inches long) was observed along a two-track road in the northern portion of the Hank Unit. Other amphibians and reptiles likely to occur within the survey area are presented in Addendum D9B.

D9.2.11 THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE SPECIES AND SPECIAL STATUS SPECIES

D9.2.11.1 Sampling Methods

Certain animals and plants are assigned special status by federal and/or state regulatory agencies through inclusion on official lists of TEPC or SS species. Inclusion on such lists may afford special protection to the listed species. Species that have been designated as TEPC or SS species by either the USFWS or the WGFD and have the potential to occur in the region are listed in Tables D9-5 and D9-6.

Prior to on-site inspection, a list of TEPC and SS species, status, and expected occurrence (i.e., habitat) was obtained from the USFWS (refer to Addendum D9A) and BLM (2006). Additionally, a database search was conducted by the WNDD for any records of TEPC and SS species that may occur in the area based on habitat type and geographic location (refer to Addendum D9A).

Throughout all phases of wildlife survey work, special vigilance was maintained for evidence of species that are listed as TEPC or SS species. Particular attention was given to locating habitats that had the potential for supporting TEPC species whose general distribution range is included within the survey area.

Three surveys were conducted for bald eagle winter roost sites in January and February 2007. Each survey included the two production units plus a 1.0-mi buffer (refer to Exhibit D9-3). The Hank Unit was surveyed using an airplane in order to cover the North Middle Butte area. The Hank Unit was surveyed on January 31 and February 6 and 19, 2007. The Nichols Ranch Unit survey was conducted on the ground using 4WD trucks on January 6, 17, and 25, 2007.

Table D9-5 Federally Listed TEPC Animal Species Potentially Occurring in the Nichols Ranch ISR Project Area.[1]

Species	Status[2]	Habitat Preference
Black-footed ferret	E	Prairie dog colonies
Bald eagle	T	Riparian

[1] Refer to Addendum D9-A.
[2] Federal Status: E = endangered; T = threatened.

Table D9-6 Special Status Species by the BLM Buffalo Field Office.[1]

Common Name	Scientific Name	Potential Habitat	Habitat Occurrence in Project area
Mammals			
Black-tailed prairie dog	*Cynomys ludovicianus*	Shortgrass prairie; eastern Wyoming	Yes
Fringed myotis	*Myotis thysanode*	Near water and wetlands	Yes
Long-eared myotis	*Myotis evotis*	Ponderosa forests, near water	No
Spotted bat	*Euderma maculatum*	Near water and wetlands	Yes
Swift fox	*Vulpes velox*	Shortgrass prairie	Yes
Townsend's big-eared bat	*Corynorhinus townsendii*	Desert shrublands, conifer and juniper woodlands near water or wetlands	Yes
Birds			
Baird's sparrow	*Ammodramus bairdii*	Midgrass prairie and meadows	Yes
Brewer's sparrow	*Spizella breweri*	Sagebrush foothills and basins	Yes
Burrowing owl	*Athene cunicularia*	Prairie dog colonies	Yes
Ferruginous hawk	*Buteo regalis*	Open grasslands and shrublands	Yes
Greater sage-grouse	*Centrocercus urophasianus*	Sagebrush basins and foothills	Yes
Loggerhead shrike	*Lanius ludovicianus*	Open country with scattered trees and shrubs	Yes
Long-billed curlew	*Numenius americanus*	Meadows, pastures, shorelines, and marshes	Yes
Mountain plover	*Charadrius montanus*	Sparse shortgrass and midgrass prairies and disturbed areas; often associated with prairie dog colonies	Yes
Northern goshawk	*Accipiter gentilis*	Coniferous forest in mountains	No
Peregrine falcon	*Falco peregrinus*	Cliffs near water	No
Sage sparrow	*Amphispiza billneata*	Sagebrush shrublands	Yes
Sage thrasher	*Oreoscoptes montanus*	Tall sagebrush and greasewood	Yes
Trumpeter swan	*Cygnus buccinator*	Wetlands, ponds, and lakes	No

Table D9-6 (Continued)

Common Name	Scientific Name	Potential Habitat	Habitat Occurrence in Project area
White-faced ibis	*Plegadis chihi*	Wetlands	Yes
Yellow-billed cuckoo	*Coccyzus americanus*	Deciduous woods and thickets (riparian) along streams and rivers	No
Amphibians			
Northern leopard frog	*Rana pipiens*	Wetlands	Yes
Spotted frog	*Ranus pretiosa*	Wetlands	Yes
Fish			
Yellowstone cutthroat trout	*Oncoryhynchus clarki bouvieri*	Lakes, rivers, and streams within the Yellowstone River drainage	No

[1] Based on PRB Wildlife Survey Protocol 2005.

D9.2.11.2 Results and Discussion

Prairie dogs are the main food of the endangered black-footed ferrets (BFF). Several black-tailed prairie dog colonies occur in and adjacent to the project area (refer to Exhibit D9-3). However, specific surveys for BFF were not conducted because the USFWS has determined that BFF surveys are no longer required in black-tailed prairie dog towns statewide (USFWS 2004; Addendum D9A).

The USFWS defines communal roosts as six or more eagles at one site; the BLM defines roosts as "consistent use areas" where eagles are seen two or more times within a given winter or multiple winters (personal communication, February 22, 2007, with Thomas Bills, biologist, BLM Buffalo Field Office). The BLM is moving away from the USFWS roost concept and protecting the "consistent use areas" because it is seldom that six or more birds are observed roosting in one area (personal communication, February 22, 2007, with Thomas Bill, biologist, BLM Buffalo Field Office). No communal roosts, as defined by the USFWS, were observed; however, several bald eagles exhibited an affinity for certain areas adjacent to the project area by

either flying or roosting in the survey area (refer to Exhibit D9-3). One adult bald eagle was observed perched in a cottonwood tree along Dry Willow Creek, just north of the Hank Unit during two of the three surveys. Based on the BLM database (2006), two roost sites have been recorded on the south side of North Pumpkin Butte and two roost sites have been recorded in Middle North Butte (refer to Exhibit D9-3).

Bald eagles were observed flying over or in the vicinity of the Nichols Ranch Unit during two of the three surveys. Two adult bald eagles were observed soaring above the Nichols Ranch Unit during the January 6th survey and one bald eagle was observed flying adjacent to the Nichols Ranch Unit during the January 17th survey.

The nearest known bald eagle winter roost site is located 4.5 mi southwest of the Nichols Ranch Unit. The closest bald eagle nest is located along the Powder River in Johnson County approximately 10 mi west of the project area (personal communication, February 22, 2007, with Thomas Bill, biologist, BLM Buffalo Field Office).

The mountain plover was formally proposed for listing under the *Endangered Species Act* in 1999; however, it was removed from consideration by the USFWS in September 2003. The mountain plover is listed as a MBHFI and as a BLM SS species. Potential mountain plover nesting habitat is present within the project area (refer to Exhibit D9-4) (BLM 2006). Such habitat includes the mixed grassland vegetation community, disturbed lands, and prairie dog colonies. Mountain plover surveys were conducted May 10 and May 23, 2006, in suitable habitat within the project area (refer to Exhibit D9-4) following the USFWS *Mountain Plover Survey Guidelines* (1999) for presence/absence surveys. The location of potential mountain plover habitat is presented in Exhibit D9-4. No mountain plovers were seen during the two surveys or during opportunistic observations throughout the 2006 field season. In addition, no records of mountain plover exist for the wildlife study area (BLM 2006; WNDD 2006). The BLM has records of mountain plover approximately 4 mi from the area (BLM 2006).

One swift fox, a BLM SS species, was observed crossing the Van Buggen road approximately 5 mi east of the project area. It is likely that swift fox inhabit the wildlife survey area because of the suitable short mixed grassland habitat.

The greater sage-grouse, a BLM SS species, is discussed in Section D9.2.3. The WNDD has occurrence records of several BLM SS species in the vicinity of the project area. BLM SS species observed include swift fox, sage sparrow, Brewer's sparrow, loggerhead shrike, sage thrasher, burrowing owl, ferruginous hawk, and northern leopard frog (refer to Addendum D9A).

D9.3.0 WILDLIFE IMPACTS AND MITIGATIVE MEASURES

Mining activities within the proposed Nichols Ranch ISR Project area will result in limited short-term loss of approximately 300 acres of wildlife habitat over the life of the operation. Short-term habitat losses will occur in those areas that are temporarily disturbed during drilling operations and during the construction of the ancillary facilities. The losses in wildlife habitat will be limited to small areas (maximum of 60-80 acres at any one time) and will be short-term in nature. The loss of wildlife habitat will be mitigated with the completion of reclamation activities.

All wildlife habitat disturbed during the life of the mine will be revegetated following the completion of mining operations (refer to the Reclamation Plan). Reclamation will be directed toward the restoration of the site primarily for livestock grazing and wildlife habitat.

The wildlife mitigation and monitoring plan for general wildlife and MBHFI (including raptors) is presented in the Mine Plan.

D9.3.1 BIG GAME

The entire project area lies within winter/yearlong pronghorn antelope and mule deer range of the Pumpkin Buttes Herd Units (WGFD 2005a). Direct impacts to big game as a result of project activities will include the disturbance of a portion of winter/yearlong range, loss of forage, increased potential for poaching, vehicular collision accidents, and the displacement of big game into surrounding areas. An estimated 300 acres will be incrementally mined or otherwise disturbed during the life of the operation. As a result of these habitat disturbances, the winter/yearlong range carrying capacity for big game will be reduced during the life of the mine and for several years following mining until vegetative growth on the revegetated areas becomes productive enough to support big game. Since only 60-80 acres will be withdrawn from use as wildlife habitat at any given time, the Nichols Ranch ISR Project is not expected to have any adverse impacts on pronghorn antelope or mule deer.

No significant increase in the potential for vehicle collision with big game is expected because of the short distances and low speeds required on the access roads. Also, levels of vehicular traffic associated with mine development and use of the roads are not expected to increase above current levels.

The number of employees and the nature and intensity of mining activities will be comparable to those already taking place on this site, and no increase in the potential for poaching and general harassment of big game is anticipated.

D9.3.2 UPLAND GAME BIRDS

Ten greater sage-grouse leks occur within the wildlife study area (refer to Exhibit D9-3). All of the leks were active in 2006. Direct impacts to greater sage-grouse from project activities would include habitat loss and fragmentation from mine, road, pipeline, and power line construction; alteration of plant and animal communities; increased human activity that could cause the birds to avoid an area; increased noise that could cause the birds to avoid an area or reduce breeding efficiency; increased motorized access by the public leading to legal and illegal harvest; direct mortality from increased vehicular traffic; and an increase in mortality from raptors if power poles are placed in occupied greater sage-grouse habitat.

To minimize impacts to breeding greater sage-grouse, project activities and vehicular traffic would be delayed or minimized in areas within 0.25 mi of an active lek between the hours of 8:00 pm and 8:00 am during the greater sage-grouse strutting period (March 1-May 15), and project activities (i.e., drilling and construction) would be minimized within 2.0 mi of an active lek between March 15 and July 15. To reduce raptor predation on greater sage-grouse, the construction of overhead power lines, permanent high-profile structures such as storage tanks, and other perch sites would not be permitted within 0.25 mi of an active lek. To minimize impacts to greater sage-grouse and other upland bird species (i.e., gray partridge), removal and disturbance of vegetation will be kept to a minimum through the use of existing roads for travel and for the placement of pipelines. All lands disturbed by project activities will be revegetated

as soon as is practicable following project completion based on practices outlined in the Reclamation Plan.

D9.3.3 WATERFOWL AND SHOREBIRDS

During the 2006 field season, waterfowl were seldom observed on the project area. This minimal use is probably due to the fact that aquatic habitats on the project area are generally seasonal in nature and higher-quality waterfowl habitat is located outside the project areas. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse impacts on waterfowl or shorebirds.

D9.3.4 MAMMALIAN PREDATORS

The use of the project area by mammalian predators will be temporarily reduced due to mining activities at the Nichols Ranch ISR Project. In addition, the recent outbreak of Tularemia may have an effect on the prey base (i.e., rabbits) for mammalian predators, which may have already resulted in a shift of predators to other areas to seek prey. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on mammalian predators.

D9.3.5 LAGOMORPHS

Rabbits were abundant within the project area and wildlife study area. Direct impacts to lagomorphs as a result of the project may include vehicular collision accidents, loss of habitat, increased motorized access by the public leading to legal and illegal harvest, and the displacement of lagomorphs into surrounding areas due to human activity and project-related noise. The natural outbreak of Tularemia has caused noticeable mortality to the rabbits in the area. Since lagomorphs are relatively abundant in the project area, and the fact that they show an affinity to disturbed areas with existing facilities such as culverts and well pads, the Nichols Ranch ISR Project is expected to have a negligible short-term adverse impacts on lagomorph populations. No adverse long-term impacts are likely to occur.

D9.3.6 SMALL MAMMALS

Because suitable habitat exists throughout the project area, some small mammals will be displaced or killed by mining-related activities over the life of the operation. However, whenever possible, Uranerz will take steps to minimize disturbance to known small mammal habitat such as black-tailed prairie dog towns, but some disturbance will be unavoidable. Because of the limited amount of disturbance (300 acres over the life of the operation), the Nichols Ranch ISR Project will have negligible short-term and long-term impacts on small mammal populations in the immediate project area.

D9.3.7 RAPTORS

In 2006, 40 raptor nests were located within the wildlife study area, of which 10 were determined to be active. Nine of the 10 active nests were located in the Hank Unit and one of the active nests was located in the Nichols Ranch Unit. Active nests observed included three red-tailed hawk, three long-eared owl, and three great horned owl nests in the Hank Unit and one golden eagle nest in the Nichols Ranch Unit. Based on the project area boundary, these trees with nests will not be removed during project activities. The principal impact to these nests from project activities and associated increased human access is potential disturbance during nesting, which could result in nest abandonment and decreased reproduction success. Potential conflicts between active nest sites and project-related activities will be mitigated by annual raptor monitoring and mitigation plans as presented in the Mine Plan.

The temporary disturbance of approximately 300 acres of raptor prey species' habitats is unlikely to result in a reduction in the raptor population in the area because only 60-80 acres will be disturbed at any time. Additionally, this reduction is expected to be short-term and negligible. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on raptor populations.

D9.3.8 NONGAME/MIGRATORY BIRDS

The temporary disturbance of approximately 300 acres of habitat, will likely result in some temporary reduction in the carrying capacity for nongame/migratory birds within the project area. Birds may be displaced by the mining activities and the temporary disturbance of wildlife habitat; however, the amount of habitat lost will be minimal in relation to the amount of comparable habitats that are available in the general area. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impact on any passerine bird populations.

D9.3.9 REPTILES AND AMPHIBIANS

The two species of reptiles that were documented in or near the project area during fieldwork are common in Wyoming. The mining activities and temporary disturbance may result in some reduction in the population levels of reptile and amphibian species in the area; however, these impacts are expected to be short-term and negligible. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on any reptiles or amphibian populations.

D9.3.10 THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE SPECIES AND SPECIAL STATUS SPECIES

Based on state and federal wildlife agencies and habitat preference, two TEPC animal species and 17 BLM SS species have the potential to occur in the project area (refer to Tables D9-3 and D9-4). Bald eagle was the only protected species observed within the wildlife study area and may use the area for foraging during the winter months and migration; however, no nests or communal roosts occur within the Nichols Ranch ISR Project wildlife survey area. Project lands disturbed as a result of mining will be unavailable for foraging bald eagles until these areas are reclaimed and prey species return. The area has been block-cleared for the black-footed ferret (refer to Addendum D9A); therefore, the mine will have no affect on black-footed ferrets.

Two BLM SS species, the swift fox and Brewer's sparrow, were observed within or adjacent to the project area. Since only 60-80 acres will be withdrawn from use as wildlife habitat at any

given time, the Nichols Ranch ISR Project is not expected to have any adverse impacts on TEPC species or SS.

D9.4.0 REFERENCES

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ADDENDUM D9A:

DOCUMENTATION OF CONTACT WITH
THE USFWS AND WNDD

11-17-06
RAS ✓
SWK ✓

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

NOV 16 2006

In Reply Refer To:
ES-61411/Mines/WY07TA0032

Roger Schoumacher
TRC Mariah Associates Inc.
Project Manager
605 Skyline Drive
Laramie, WY 82070-8909

Dear Mr. Schoumacher:

This is in response to your letter dated October 25, 2006, received in our office on October 26, requesting a list of threatened, endangered, proposed, and candidate species for a proposed *in situ* uranium recovery project in Campbell and Johnson counties, Wyoming (T75-76W, R43-44N). We are providing you with information on (1) threatened, endangered and candidate species, (2) migratory birds, (3) wetlands and riparian areas, (4) sensitive species, and (5) water quality. The U.S. Fish and Wildlife Service (Service) provides recommendations for protective measures for threatened and endangered species in accordance with the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Protective measures for migratory birds are provided 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 and the Fish and Wildlife Act of 1956, as amended, 70 Stat. 1119, 16 U.S.C. 742a-742j.

In accordance with Section 7(c) of the Act, my staff has determined that the following listed species may be present in the proposed project area in Campbell and Johnson counties, Wyoming. We would appreciate receiving information as to the current status of each of these species within the proposed project area.

SPECIES	STATUS	HABITAT
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Found throughout state
Black-footed ferret (*Mustela nigripes*)	Endangered	Prairie dog towns
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	Threatened	Seasonally moist soils and wet meadows of drainages below 7000 feet elevation

Bald eagle: While habitat loss and human disturbance remains a threat to the bald eagle's full recovery, most experts agree that its recovery to date is encouraging. 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. Because bald eagles are particularly sensitive to human disturbance at their nests and communal roosts, protective buffers should be implemented around these areas [Buehler et al. 1991, Greater Yellowstone Bald Eagle Working Group (GYBEWG) 1996, Montana Bald Eagle Working Group (MBEWG) 1994, Stalmaster and Newman 1978, U.S. Fish and Wildlife Service (USFWS) 1986].

In Wyoming, bald eagle nest buffer recommendations include avoiding project-related disturbance and habitat alteration within 1 mile of bald eagle nests. The nesting season occurs from February 1 to August 15 and bald eagle nest buffers should receive maximum protection during this time period. For some activities (construction, seismic exploration, blasting, and timber harvest), a home range buffer may include potential foraging habitat for 2.5 miles from the nest (GYBEWG 1996). We recommend that you contact the U.S. Fish and Wildlife Service to determine the potential impact of your activity to nesting bald eagles if your project will cause disturbance within one of these nest buffer areas.

A communal roost is defined as an area where six or more eagles spend the night within 100 meters (328 feet) of each other (GYBEWG 1996). For bald eagle communal winter roosts, we recommend that disturbance be restricted within 1 mile of known communal winter roosts during the period of November 1 to April 1. Additionally, we recommend avoiding disturbance and habitat alteration within 0.5 mile of active roost sites year round.

Disturbance sensitivity of roosting and nesting bald eagles may vary between individual eagles, topography, density of vegetation and intensity of activities. The buffers and timing stipulations, as described above, should be implemented unless site-specific information indicates otherwise (Stalmaster and Newman 1978, USFWS 1986). Modification of buffer sizes may be permitted where biologically supported and in coordination with the Service.

D9A-2

Black-footed ferret: Black-footed ferrets may be affected if prairie dog towns are impacted. Please be aware that black-footed ferret surveys are no longer recommended in black-tailed prairie dog towns statewide. However, we encourage protection of all prairie dog towns for their value to the prairie ecosystem and the myriad of species that rely on them. We further encourage you to analyze potentially disturbed prairie dog towns for their value to future black-footed ferret reintroduction.

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 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.

Migratory Birds

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. In addition, we have enclosed a list of Migratory Bird Species of Management Concern in Wyoming (Migratory Birds of High Federal Interest) for use in your analysis.

Work that could lead to the take of a migratory bird including an eagle, their young, eggs, or nests (for example, if you are going to construct roads, or power lines in the vicinity of a nest), should be coordinated with our office before any actions are taken. 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

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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.

Wetland and Riparian Areas

Wetlands associated with streams, creeks, and rivers 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. The Service recommends measures be taken to avoid and minimize wetland losses in accordance with Section 404 of the Clean Water Act, and Executive Order 11988 (floodplain management) as well as the goal of "no net loss of wetlands." 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.

Greater Sage-Grouse:
As you know, the Service has determined that the greater sage-grouse (*Centrocercus urophasianus*) is unwarranted for listing at this time. However, the Service continues to have concerns regarding sage-grouse population status, trends and threats, as well as concerns for other sagebrush obligates. The following information is provided for your use in the evaluation of proposed actions and their potential effects to the sage-grouse.

Greater sage-grouse are dependent on sagebrush habitats year-round. 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 (Braun 1998, Wisdom et al. 2002). 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 1 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 mitigative measures to minimize potential impacts from the proposed 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.

Water Quality

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). Boon (1989) reported that uranium deposits in Converse County, Wyoming, can contain up to 4,500 µg/g (ppm) of selenium. In situ mining of uranium is done by injecting a leaching solution of native ground water containing dissolved oxygen and carbon dioxide into the uranium-bearing formation through injection wells. The leaching solution dissolves selenium present in the formation. 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. Another disposal option that is not commonly used involves land application using center-pivot irrigation after treatment for removal of uranium and radium.

In 1998, the Service conducted a study of a 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. 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 µg/L are considered hazardous to the health and long-term survival of fish and wildlife (Lemly 1996). Additionally, water with more than 20µg/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 µg/g in pondweed (*Potamogeton vaginatus*) collected from a uranium mine wastewater storage reservoir that had waterborne selenium concentrations ranging from 260 to 350 µg/L. The potential for wastewater disposal to mobilize selenium through terrestrial and aquatic food chains should be assessed to assist in selecting a wastewater disposal option which would avoid or minimize impacts to fish and wildlife resources.

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We appreciate your efforts to ensure the conservation of endangered, threatened, and candidate species and migratory birds. When the lead Federal agency for this project is determined, please coordinate with the Buffalo Field Office of the BLM or the Nuclear Regulatory Commission (NRC) in Arlington, Texas. If you have further questions regarding our comments or your responsibilities under the Act, please contact Jan McKee of my staff at the letterhead address or phone (307) 772-2374, extension 242.

Sincerely,

Patricia Deibert

for Brian T. Kelly
Field Supervisor
Wyoming Field Office

cc: NRC, Arlington, Texas
WDEQ, Land Quality Division, Sheridan, WY,
WGFD, Cheyenne, WY, Statewide Habitat Protection Coordinator (V. Stelter)
WGFD, Lander, WY, Non-game Coordinator (B. Oakleaf)

Enclosure

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Enclosure 1

Migratory Bird Species of Management Concern in Wyoming

(Migratory Birds of High Federal Interest)

Based on the *Wyoming Bird Conservation Plan* (Cerovski et al. 2000)

May 2, 2002

U.S. Fish and Wildlife Service, Wyoming Field Office,
4000 Airport Parkway, Cheyenne, Wyoming 82001

The Wyoming Field Office of the U.S. Fish and Wildlife Service (Service) has compiled the following list from the ongoing work among State and Federal agencies, non-governmental organizations, and the interested public that produced the Wyoming Bird Conservation Plan. This list will now serve as the Service's list of Migratory Bird Species of Management Concern in Wyoming, in place of the previous list based on the Migratory Nongame Birds of Management Concern in the United States: the 1995 List. The Wyoming Bird Conservation Plan identified priority species based on a number of criteria (see below) using the best information available for these generally un-studied species. In many cases, this list reflects identified threats to habitat because no information is available on the species population trends. In some cases it reflects identified population declines though no causal factors have been identified.

The following tables and explanatory text are taken directly from the Wyoming Bird Conservation Plan (Cerovski et al. 2000). For more information on this listing process, this report is available from the Service's Wyoming Field Office, 4000 Airport Parkway, Cheyenne, Wyoming 82001; or Wyoming Game and Fish Department (WGFD), Nongame Branch, 260 Buena Vista, Lander, Wyoming 82520.

Table 1. **Level I Species (Conservation Action)**. Species clearly needs conservation action. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, and the need for additional knowledge through monitoring and research into basic natural history, distribution, etc.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Mountain Plover[d]	28	4	3	Shortgrass Prairie, Shrub-steppe
Trumpeter Swan	26	3	3	Wetlands
Sage Grouse	26	5	3	Shrub-steppe
McCown's Longspur	26	3	2	Shortgrass Prairie, Shrub-steppe
Baird's Sparrow	26	2	3	Shortgrass Prairie
Ferruginous Hawk	23	4	3	Shrub-steppe, Shortgrass Prairie

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Table 1. **Level I Species (Conservation Action)**, continued.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Brewer's Sparrow	23	5	5 Shrub	Shrub-steppe, Mountain-foothills
Wilson's Phalarope	22	3	5	Wetlands
Franklin's Gull	22	3	3	Wetlands
Sage Sparrow	22	5	2	Shrub-steppe, Mountain-foothills Shrub
Swainson's Hawk	21	3	3	Plains/Basin Riparian
Long-billed Curlew	21	2	3	Shortgrass Prairie
Short-eared Owl	20	3	3	Shortgrass Prairie
Northern Goshawk	19	4	3	High Elevation Conifer, Mid Elevation Conifer, Aspen
Peregrine Falcon	19	3	3	Specialized (cliffs)
Burrowing Owl	19	3	4	Shortgrass Prairie
Forster's Tern	19	2	3	Wetlands
Bald Eagle	18	3	3	Montane Riparian, Plains/Basin Riparian
Upland Sandpiper	18	2	2	Shortgrass Prairie
Black Tern	18	3	3	Wetlands
Whooping Crane	n/a	n/a	n/a	Wetlands
Piping Plover	n/a	n/a	n/a	Wetlands, Aquatic

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database, Carter et al. 1997).
[c] PT = Population Trend (from the PIF Priority Database, Carter et al. 1997).
[d] Species in all capital letters previously appeared on the Service's 1995 list.

Table 2. **Level II Species (Monitoring).** The action and focus for the species is monitoring. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, species whose population trend is unknown, species that are peripheral for breeding in the habitat or state, or species for which additional knowledge is needed.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Calliope Hummingbird	23	5	3	Mid Elevation Conifer, Montane Riparian
Lewis' Woodpecker	23	3	3	Low Elevation Conifer, Plains/Basin Riparian
Cassin's Kingbird	22	3	3	Juniper Woodland, Plains/Basin Riparian
Lark Bunting	22	4	4	Shortgrass Prairie, Shrub-steppe
American White Pelican	21	3	3	Aquatic
Williamson's Sapsucker	21	3	3	Mid Elevation Conifer
Black-backed Woodpecker	21	3	3	Mid Elevation Conifer, High Elevation Conifer
Gray Flycatcher	21	3	3	Juniper Woodland, Mountain-foothills Shrub
Juniper Titmouse [d]	21	3	3	Juniper Woodland
Dickcissel	21	3	3	Shortgrass Prairie
Chestnut-collared Longspur	21	2	3	Shortgrass Prairie
Harlequin Duck	20	3	3	Montane Riparian
Snowy Plover	20	3	3	Wetlands
Black-chinned Hummingbird	20	2	3	Plains/Basin Riparian, Shrub-steppe
Rufous Hummingbird	20	2	3	Mid Elevation Conifer
Red-naped Sapsucker	20	3	2	Aspen
Three-toed Woodpecker	20	4	3	Mid Elevation Conifer, High Elevation Conifer
Willow Flycatcher	20	3	4	Montane Riparian, Plains/Basin Riparian
Hammond's Flycatcher	20	2	3	High Elevation Conifer with Aspen, Montane Riparian
Cordilleran Flycatcher	20	3	3	Montane Riparian, Mid Elevation Conifer
Pygmy Nuthatch	20	3	3	Low Elevation Conifer
Marsh Wren	20	3	4	Wetlands
American Dipper	20	3	3	Montane Riparian

Table 2. **Level II Species (Monitoring)**, continued.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Plumbeous Vireo	20	3	3	Mid Elevation Conifer, Low Elevation Conifer
Townsend's Warbler	20	3	3	High Elevation Conifer, Mid Elevation Conifer
Dusky Flycatcher	19	3	2	Low Elevation Conifer, Aspen, Mountain-foothills Shrub
Western Bluebird	19	3	3	Juniper Woodland, Low Elevation Conifer
Sage Thrasher	19	5	2	Shrub-steppe
Grasshopper Sparrow	19	3	5	Shortgrass Prairie, Shrub-steppe
Bobolink	19	2	3	Shortgrass Prairie, Shrub-steppe
Common Loon	18	3	3	Wetlands
Black-billed Cuckoo	18	2	3	Plains/Basin Riparian
Red-headed Woodpecker	18	2	3	Plains/Basin Riparian, Low Elevation Conifer
Yellow-billed Cuckoo	18	3	3	Plains/Basin Riparian
Eastern Screech-Owl	18	3	3	Plains/Basin Riparian
Western Screech-Owl	18	3	3	Plains/Basin Riparian
Great Gray Owl	18	3	3	Mid Elevation Conifer, High Elevation Conifer
Boreal Owl	18	3	3	High Elevation Conifer
Broad-tailed Hummingbird	18	2	2	Montane Riparian, Plains/Basin Riparian, Mid Elevation Conifer
Western Scrub-Jay [d]	18	3	3	Juniper Woodland
Loggerhead Shrike	18	3	3	Shrub-steppe
Vesper Sparrow	18	5	4	Shrub-steppe
Lark Sparrow	18	3	4	Shrub-steppe
Golden-crowned Kinglet	17	3	3	High Elevation Conifer
MacGillivray's Warbler	17	3	1	Montane Riparian, Plains/Basin Riparian
Ash-throated Flycatcher [d]	16	2	3	Juniper Woodland
Bushtit [d]	16	3	3	Juniper Woodland
Brown Creeper	16	3	3	Mid Elevation Conifer, High Elevation Conifer
Merlin	15	3	3	Low Elevation Conifer
Sprague's Pipit	n/a	n/a	n/a	Grassland, Plains/Basin Riparian, Shortgrass Prairie
Barn Owl	n/a	n/a	n/a	Shortgrass Prairie, Urban
White-faced Ibis	n/a	n/a	n/a	Wetlands, Aquatic

Table 2. **Level II Species (Monitoring)**, continued.

American Bittern	n/a	n/a	n/a	Wetlands, Aquatic
Common Tern	n/a	n/a	n/a	Wetlands, Aquatic
Purple Martin	n/a	n/a	n/a	Wetlands, Aquatic/Basin Riparian, Montane Riparian

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database).
[c] PT = Population Trend (from the PIF Priority Database).
[d] Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

Wyoming Partners In Flight Process for Prioritizing Species

Wyoming Partners In Flight participants developed the current list of priority species based on a combination of the seven criteria in the national Partners In Flight Priority Database (Carter et al. 1997). This database serves as a defensible method of prioritizing both species and habitats in need of conservation. The criteria include Wyoming-dependent and Wyoming-independent factors. The Wyoming-independent criteria are constant over a species' range and do not vary for each species. The Wyoming-dependent criteria were the key components used to prioritize species and their conservation action needs. In the absence of any more rigorous statewide surveys, Breeding Bird Survey data dating back to 1968 were used to determine population trends in Wyoming.

Criteria

Within each criterion below, a species was given a rank score ranging from 1 to 5, with 1 being the least critical rank and 5 the most critical. Each ranked species could potentially receive a low score of 7 and a high score of 35. However, setting conservation goals based only on total score could be misleading; therefore, each total score was reviewed in conjunction with its component parts. In Wyoming, species were initially ranked using total score, area importance, and population trend.

1. Relative Abundance (RA) - The abundance of a bird, in appropriate habitat within its entire range, relative to other bird species. This criterion gives an indication of a species' vulnerability to withstand cataclysmic environmental changes. A low score would indicate a higher relative abundance, therefore reducing the risk of complete extirpation from losses in one or more regions. Higher scores indicate a lower relative abundance, thus more vulnerability to drastic losses or population changes.

2. Breeding Distribution (BD) - A relative measure of breeding range size as a proportion of North America [defined as the main body of the continent, excluding Greenland, through Panama and the islands of the Caribbean, comprising an area of 22,059,680 km^2 (National Geographic Society 1993)], and as such it provides an index of a species' vulnerability to

random environmental events. High scores indicate localized breeding, thus a higher likelihood of serious decline from drastic environmental changes. Low scores indicate wide breeding distribution, therefore less likelihood of extirpation. Used for breeding birds only.

3. Non-breeding Distribution (ND) - A relative measure of non-breeding, or winter, range size as a proportion of North America, and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized distribution on the non-breeding grounds. Low scores indicate wide distribution on the non-breeding grounds, therefore less likelihood of extirpation. Used for wintering birds only.

4. Threats on Breeding Grounds (TB) - The ability of a habitat in an area to support populations of a species in that area. Two factors are considered here: 1) each species' demographic and ecological vulnerability (the potential inability of a species to recover from population loss by normal reproductive effort due to low reproductive rate, high juvenile mortality, or both; and the level of ecological specialization of a species and, hence, its potential inability to withstand environmental change), and 2) habitat loss or disruption (a combination of the amount of habitat or conditions necessary for survival and reproductive success that has been lost since 1945, and the amount that is anticipated to be lost in the future). High scores indicate either a large loss of habitat or a species that is an extreme ecological specialist. Low scores indicate a stable or increasing habitat or a species that is an ecological generalist. Used for both breeding and wintering birds.

5. Threats on Non-breeding Grounds (TN) - Range-wide threats on non-breeding, or winter, grounds. This is scored using the same criteria as threats on breeding grounds but reflects non-breeding issues, including migratory habitat. Used for wintering birds only.

6. Population Trend (PT) - The overall population trend of each species assigned independently for each state, province, or physiographic area. This criterion must meet two thresholds, reliability and magnitude, to warrant either a very high or very low score. When possible, a score was assigned using BBS data, which incorporated a population trend uncertainty score based on the statistical validity of the BBS data (i.e. a species must be detected on a minimum of 14 BBS routes per state for population trends to have statistical significance). This criterion was chosen to alert managers to species with modest, but certain, population declines.

7. Area Importance (AI) - The abundance of a species within a state, province, or physiographic area relative to its abundance throughout its range. This criterion helps direct conservation efforts toward areas that are most important to a species' survival. Area Importance is scored locally; therefore, high scores indicate that a large proportion of the species' breeding or winter range occurs in Wyoming, or a species is using a habitat that is only available in Wyoming. Low scores indicate that a small proportion of the species' range occurs in Wyoming, or the preferred habitat is widespread across its range. Used for both breeding and wintering birds.

Priority Species

Priority bird species in Wyoming were identified from the PIF Priority Database (Carter et al. 1997) and by qualitative, informed decisions. Those species with a total score of 18 or above, Area Importance (AI) of 3 or above, and/or Population Trend (PT) of 3 or above from the database, or with a total score less than 18 but of significant local interest were identified as the highest priority species. However, as more information becomes available, the highest priority species for Wyoming may change, as this is a dynamic database that allows for updated information to be periodically inserted and reviewed. The primary habitat type or types required for breeding were identified for each species to determine the highest priority habitat types for the state.

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S 1825, 5.1

UNIVERSITY OF WYOMING

Wyoming Natural Diversity Database
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(307) 766-3023 • fax (307) 766-3026 • e-mail: wndd@uwyo.edu • www.uwyo.edu/wyndd

30 March 2006

Roger Schoumacher
TRC Mariah Associates, Inc.
605 Skyline Drive
Laramie, WY 82070

Dear Roger,

Attached are the results of your request for documented rare species occurrences in T43-44N R74-77W, Johnson and Campbell Counties, Wyoming. A buffer of adjacent townships was also queried to provide adequate information for the appropriate application of these data. The Excel spreadsheet summarizes the results of your request.

Data are in the form of ArcView shapefiles in UTM zone 12 NAD83. The attached Data Dictionary goes over file naming conventions and defines the column headings of the fields included in your shapefiles. For additional information about abbreviations in the shapefiles please refer to the Codes and Definitions portion of our website at http://uwadmnweb.uwyo.edu/WYNDD/.

Comments from our botanist, Bonnie Heidel (307-766-3020, bheidel@uwyo.edu), and zoologist, Doug Keinath (307-766-3013, dkeinath@uwyo.edu), will be forwarded to you as soon as they have an opportunity to review the requested area and formulate responses. These files provide further information regarding potential species occurrences in the area as well as habitat information. We have no documentation of vegetation communities that we track in the area of interest.

Recommended citation:
Wyoming Natural Diversity Database. 2005. Data compilation for R. Schoumacher, completed March 30, 2006. Unpublished report. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

WYNDD would benefit greatly from the sharing of any new information on species locations that result from your project. Please contact us about our data trading policy, which would help your organization reduce costs while improving and updating our database.

We will send you a bill under separate cover for $50.00 (Tier 1 Data Request: 8 Townships x 625 taxa = 5000 (<6251)).

Thank you for your data request. Please do not hesitate to call if you have any questions about the search. We ask that you not disseminate these data, except to the Wyoming Department of Environmental Quality, without our permission.

Sincerely,
Melanie Arnett
Database Specialist
(307) 766-2296
arnett@uwyo.edu

DNA-17

ZOOLOGICAL COMMENTS

Wyoming Natural Diversity Database

Prepared for: Roger Schoumacher - TRC Mariah Associates, Inc.
Date: 31 March 2006
Project Description: WDEQ mine permit for an in-situ uranium mine. T43-44N R74-77W, Johnson and Campbell Counties, Wyoming

HABITAT NOTES:

Towns: The request area is ca 10-33 miles west of Wright.
Water: The Belle Fourche and Dry Fork Powder Rivers flow through the request area along with the following creeks: All Night, Big Willow Bullwhacker, Cottonwood, East Fork Bullwhacker, Fourmile, Greasewood, House, Little Bullwhacker, Little Willow, Mud Spring, North Cottonwood, North Fourmile, North Prong Willow, Seventeenmile, South All Night, South Prong Pumpkin, West Fork Bullwhacker, and Willow. At least 15 small reservoirs and/or ponds/lakes are found in the request area.
Habitat: The request area consists of Grass Riparian, Irrigated Crops, Mixed-Grass Prairie, Ponderosa Pine, and Wyoming Big Sage Steppe.
Approximate Elevation: 4,400-6,000 ft.

ZOOLOGY COMMENTS:

Please report new occurrences of any of these species to WYNDD so that our database continues to be current and useful to future requesters. Thank you!

These data represent what we currently have in our Biotics database as well as our informed opinion about what might occur in the request area if local habitat is appropriate (**species documented in our Biotics database are presented in bold face type**). Please note that absence of a species occurrence in our database is not proof that the species in question does not exist there. It is highly possible that people have never looked for, or reported, information on the species in question in the request area. Our data for private land is particularly sparse, so absence of observations on private parcels should be viewed with caution. Also, please note that (in general) only animals likely to breed or winter near the project area have been included in this list. Other animals, particularly migratory birds, may use portions of the study area in other seasons. Finally, this list includes only species that we actively track in our database, the full list of which can be found on our website (http://uwadmnweb.uwyo.edu/wyndd/).

Prepared by: Melanie Arnett, Database Specialist, arnett@uwyo.edu
Direct questions to: Doug Keinath, Zoologist; dkeinath@uwyo.edu

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Bold = Documented in our Biotics database. * = Documented request area.

Sensitive BIRDS Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Bald eagle	Haliaeetus leucocephalus	G4/S3B/S5N	USFWS ESA Threatened (T, AD), WGFD CWCS, WGFD NSS2	Wooded areas usually along rivers, lakes, reservoirs. Sometimes in open country
Ferruginous hawk*	**Buteo regalis**	**G4/S4B/S5N**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3**	**Open grasslands and shrublands**
Golden eagle*	**Aquila chrysaetos**	**G5/S3B**		**Open grasslands and shrublands esp. around cliffs and canyons**
Merlin	Falco columbarius	G5/S4	WGFD CWCS, WGFD NSS3	Open woodlands, grasslands, and shrublands sometimes in cities in winter
Greater sage grouse*	**Centrocercus urophasianus**	**G4/S4**	**USFWS ESA Petitioned, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2**	**Sagebrush basins and foothills, generally close to water**
Sandhill crane	**Grus canadensis**	**G5/S3B/S5N**	**WGFD CWCS, WGFD NSS3**	**Meadows, marshes, shorelines, and grain fields**
Mountain plover	**Charadrius montanus**	**G2/S2**	**USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sparse shortgrass or mixed grass prairie. Also in short-sagebrush plains. Often associated with prairie dog towns.**
American avocet	Recurvirostra americana	G5/S3B		Marshes, ponds, and shores, esp. alkaline areas
Long-billed curlew	Numenius americanus	G5/S3B	WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Meadows, pastures, shorelines, and marshes
Black tern (Breeding colonies)	Chlidonias niger	G4/S1	S-USFS R2, WGFD CWCS, WGFD NSS3	Ponds, lakes, reservoirs, and marshes
Yellow-billed cuckoo	Coccyzus americanus	G5/S1	USFWS ESA Candidate (C), WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Deciduous woods and thickets, usually along large streams
Short-eared owl*	**Asio flammeus**	**G5/S2**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Open grasslands, meadows, marshes, and farmland, especially around tall grass or weeds**
Eastern screech owl	Otus asio	G5/S3		Wooded river and stream bottoms, usually with cottonwoods
Burrowing owl*	**Athene cunicularia**	**G4/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Plains and basins, often associated with prairie dog towns**
Chimney swift	Chaetura pelagica	G5/S3B		Cities and towns, usually over buildings
Williamson's sapsucker	Sphyrapicus thyroideus	G5/S2		Old-growth conifer forest, especially a mixture of spruce and lodgepole pine
Loggerhead shrike*	**Lanius ludovicianus**	**G4/S3**	**WY BLM SSL, S-USFS R2**	**Open country with scattered trees and shrubs**
Canyon wren	Catherpes mexicanus	G5/S2S3		Rocky canyons and cliffs
American dipper	Cinclus mexicanus	G5/S4		Fast flowing rocky streams mostly in mountains, moves to lower elev. streams and rivers in winter
Sage thrasher*	**Oreoscoptes montanus**	**G5/S5**	**WY BLM SSL, WGFD CWCS, WGFD NSS4**	**Tall sagebrush and greasewood**
Sage sparrow	**Amphispiza belli**	**G5/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Medium to tall sagebrush shrubland**
Baird's sparrow	Ammodramus bairdii	G4/S1B?/SZN	WY BLM SSL, WGFD NSS4	"Mid-grass" prairie and meadows
Grasshopper sparrow*	**Ammodramus savannarum**	**G5/S4**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**"Mid-grass" prairie, tall-grass prairie, hay meadows, and open savanna.**
Clay-colored sparrow*	**Spizella pallida**	**G5/S3B**		**Brushy riparian areas and brushy woodland edges**

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Brewer's sparrow*	**Spizella breweri**	**G5/S5**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sagebrush foothills and medium-height sagebrush in basins. Also, mountain mahogany hills.**
McCown's longspur*	**Calcarius mccownii**	**G5/S2**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Sparsely vegetated shortgrass prairie**
Chestnut-collared longspur*	**Calcarius ornatus**	**G5/S1**	**S-USFS R2, WGFD CWCS, WGFD NSS4**	**Medium height grass, especially meadows around ponds**

Sensitive MAMMALS Documented or Potentially in Request Area				
Common Name	**Scientific Name**	**Heritage Rank**	**Management Status**	**Habitat Notes**
Dwarf shrew*	**Sorex nanus**	**G4/S4**	**WGFD CWCS, WGFD NSS3**	**Historically, found in alpine rubble slopes and conifer forests above 4,000 m. Sometimes found in prairie and pinyon-juniper at lower elevations.**
Long-legged myotis	Myotis volans	G5/S3	WGFD CWCS, WGFD NSS2	Found in conifer and deciduous forests. Roosts include tree and rock crevices, snages and buildings.
Long-eared myotis	Myotis evotis	G5/S4	WY BLM SSL, WGFD CWCS, WGFD NSS2	Found in conifer forests, especially ponderosa pine. Forage over water holes and possible openings in conifer forest. Roosts: caves, buildings, mines.
Silver-haired bat	Lasionycteris noctivagans	G5/S3	WGFD CWCS, WGFD NSS4	Occur in a wide variety of habitats across Wyoming. Roosts: trees, caves, mines, houses
Hoary bat*	**Lasiurus cinereus**	**G5/S4**	**WGFD CWCS, WGFD NSS4**	**Widespread and mobile, hoary bats are found in shrublands, grasslands, and aspen-pine forests near roosting habitat. Roosts: deciduous trees.**
Townsend's big-eared bat	Corynorhinus townsendii	G4/S2	WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS2	Hibernates and day-roosts in caves and mines and will use buildings as day roosts. Typical habitat includes desert shrublands, pinyon-juniper woodlands, and dry conifer forests, generally near riparian or wetland areas.
Wyoming ground squirrel	Spermophilus elegans	G5/S3S4	WGFD CWCS, WGFD NSS6	Found in open habitats from sage grasslands to alpine meadows.
Black-tailed prairie dog	Cynomys ludovicianus	G4/S2	USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS3	Shortgrass prairie, usually with loose, sandy soils. Can form large, dense colonies.
Olive-backed pocket mouse	Perognathus fasciatus	G5/S4	WGFD CWCS, WGFD NSS3	Dry habitats ranging from gravelly soils to sandy areas of short grass prairies to sand dunes.
Swift fox*	**Vulpes velox**	**G3/S2**	**USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Swift foxes occupy shortgrass prairie, but can be found in sage-grasslands. They are particularly found in sparely vegetated areas such as prairie dog towns.**
RED FOX	Vulpes vulpes	G?/T1Q/S1		Red fox are found in intermixed communities of brush, streamsides, pastures, farmlands, and other open areas.
Common gray fox	Urocyon cinereoargenteus	G5/S2		Gray fox are usually found in deciduous forests, riparian areas, and shrubland in hilly country.
Black-footed ferret	**Mustela nigripes**	**G1/S1**	**USFWS ESA Endangered (E, EXPN), WGFD CWCS, WGFD NSS1**	**Black-footed ferrets always occur in or near prairie dog colonies, generally on short or mixed-grass prairie.**

Plains (eastern) spotted skunk	Spilogale putorius interrupta	G5/T4/S3		Usually occur near riparian areas, but also found near human settlements (fence rows, barns, brush piles, etc.).

Sensitive HERPTILES Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Tiger salamander*	**Ambystoma tigrinum**	**G5/S4**	**WGFD CWCS, WGFD NSS4**	**Tiger salamanders can be found in fairly moist environments ranging from rodent burrows to window wells to burrows in sand dunes. Larvae found in intermittent streams, ponds, and lakes.**
Great plains toad	Bufo cognatus	G5/S3	WGFD CWCS, WGFD NSS4	Great Plains toads can be found in grassland communities near ponds and lakes.
Northern leopard frog*	**Rana pipiens**	**G5/S3**	**WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4**	**Found near permanent water in areas up to about 9,000 feet. Lower elevation sites are usually swampy cattail marshes and higher ones tend to be beaver ponds.**
Milk snake	Lampropeltis triangulum	G5/S3	WGFD CWCS, WGFD NSS2	Milk snakes can be found in woodlands along escarpments in prairie communities below about 6,000 feet.
Eastern yellowbelly racer	Coluber constrictor flaviventris	G5/T5/S4	WGFD CWCS, WGFD NSS4	The eastern yellow belly racer is found in woodland communities in the plains and foothills zones, usually in the vicinity of water.

Sensitive FISH Documented or Potentially in Request Area

Common Name	Scientific Name	Heritage Rank	Management Status	Habitat Notes
Goldeye	Hiodon alosoides	G5/S2	WGFD CWCS, WGFD NSS2	Goldeye are found in large, often turbid rivers, as well as backwaters, marshes, and shallows in larger lakes and reservoirs. In Wyoming they occur in the Powder, Little Powder, and Missouri Rivers, as well as Clear Creek and Crazy Woman Creek.
Western silvery minnow	Hybognathus argyritis	G4/S2	WGFD CWCS, WGFD NSS1	The western silvery minnow generally inhabits larger rivers, perhaps slow-flowing and silty bottomed. In Wyoming it seems to occur in the Powder and Little Missouri River drainages, and has likely been extirpated from the Big Horn River by construction.
Finescale dace	Phoxinus neogaeus	G5/S2	S-USFS R2, WGFD CWCS, WGFD NSS1	Finescale dace live in "cool, weedy, small streams, ponds and small lakes". It is common in more northern reaches of the country, but in Wyoming has been found in the Niobrara River (near Nebraska) and in various places in Crook County.
Yellowstone cutthroat trout (Native populations)	Oncorhynchus clarki bouvieri	G4/T2/S2	USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Historically Yellowstone cutthroat trout lived in lakes, rivers and streams of the Yellowstone River drainage (including Yellowstone Lake). Also found in the Snake, Tongue, Bighorn, and Clarks Fork Drainages.

09A-21

Wyoming Natural Diversity Database

Data Request File Naming Conventions and Data Dictionary

Describes the column headings (see table) and **file naming conventions (words in bold)** for ArcView shapefiles (**.shp**) generated from our Biotics database.

A species or natural community is referred to as an Element.

eorep (Element Occurrence Representation)

An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population (*e.g.*, long distance dispersers) or a group of nearby populations (*e.g.*, metapopulation). For community Elements, the EO may represent a stand or patch of a natural community, or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries.

An Element Occurrence Representation (EOREP) is a data management tool that has both spatial and tabular components including a mappable feature and its supporting database. EOs are typically represented by bounded, mapped areas (polygons) of land and/or water. EO Representations are most commonly created for current or historically known occurrences of natural communities or native species of conservation interest. They may also be created, in some cases, for extirpated occurrences. All EOREPs encompass one or more observations (Source Features).

source (Source Feature)

Source Features represent individual observations of a specific Element at a specific place and time. They can be represented by points (**source_pt**), lines (**source_line**), or polygons (**source_poly**). If certain criteria (e.g. "evidence of breeding" or "within X kilometers of another Source Feature of the same Element with no separation barriers") are met, individual Source Features are incorporated into an Element Occurrence Representation. Source Features that do not qualify for inclusion in an EOREP remain independent (INDEPEN_SF = Y).

We are currently in the process of revising our Source Feature attribute table according to the new data methodology in Biotics. Records that have yet to be revised will only contain identification numbers and the text "HDMS DEFAULT CONVERSION VALUES" in the DESCRIPTOR field. Note that the point Source Feature for these unrevised records is equivalent to the centroid of the EO (from the old BCD methodology). Observation and survey data for these records can still be found in the EO_DATA field in EOREP files (the EOREP and related SOURCE files can be cross-referenced using the 'EO_ID' field). Please bear with us during this transitional period.

data_sensitive (separate shapefiles are made for data that are sensitive in our Biotics database)

These records are provided at the township scale only. Data are considered sensitive if they meet one or more of the following criteria:

1. Records of Source Features and/or Element Occurrences on private land that are not documented in publicly available references, but for which WYNDD has permission from the land owner to archive and disseminate at the township level.
2. Records of Source Features and/or Element Occurrences submitted to WYNDD by an outside party who has requested that the data be treated as sensitive.
3. Source Features and/or Element Occurrences that are especially sensitive to disturbance, over-harvest, over-collection, intentional destruction, or unintentional destruction.
4. Element Occurrences that encompass one or more Source Features that are considered sensitive for any reason.

boundary - The shapefile that demarcates the boundary of the request and buffer areas.

Precise information is not distributed for fields in italics: this applies to sensitive data records.

Biotics SOURCE	Biotics EOREP	DEFINITION
FEATURE_ID	FEATURE_ID	A unique identification code for the shape in Biotics.
DATA_SENS	DATA_SENS	Data are sensitive: Y - Yes. *Specific location is not released.* Data are found in separate shapefiles at the township scale. N - No.
Area	Area	Request or Buffer Area Request - Occurrence intersects the request area. Buffer - Occurrence intersects the buffer area only.
ELEM_TYPE	ELEM_TYPE	Taxonomic grouping of Element.
ELCODE	ELCODE	Element code assigned to each species by NatureServe.
SNAME	SNAME	Scientific name.
COMNAME	COMNAME	Common name.
G_RANK	G_RANK	Global Heritage rank assigned by NatureServe.
S_RANK	S_RANK	State Heritage rank assigned by WYNDD biologists.
USFWS_ESA	USFWS_ESA	Status under the United States Fish and Wildlife Service Endangered Species Act.
AGENCYSTAT	AGENCYSTAT	Status assigned by: United States Forest Service: S-USFS R2 - Sensitive in Region 2 S-USFS R4 - Sensitive in Region 4 Wyoming Bureau of Land Management: WY BLM SSL - On Sensitive Species List Wyoming Game and Fish Department: CWCS - Species part of Comprehensive Wildlife Conservation Strategy NSS1-NSS7 - Native Species Status with NSS1 being the most imperiled
TRACKSTAT	TRACKSTAT	Tracking Status: Y - Element tracked by WYNDD. W - Element watched for potential tracking.
	COUNTY	County name.
OBS_DATE	SURVEYDATE FIRST_OBS LAST_OBS	❖ SOURCE - OBS_DATE Observation date(s). ❖ EOREP - SURVEY DATE Date of the last known survey at this location. ❖ EOREP - FIRST_- and LAST_OBS The first and last date, respectively, the Element was observed at this location.
LOCATOR	TOWN_RANGE *SECTION*	❖ SOURCE - LOCATOR Township/Range/*Section* (format: 045N118W *Sec 23 SE4) and sometimes a brief description of specific location.* ❖ EOREP - TOWN_RANGE and *SECTION* Township/Range and *Section.*
TRS_NOTE	*TRS_NOTE*	*Township/Range/Section comments. Usually ¼ ¼ sections.*
OBSERVER		*Observer.* EOREP - nested in the EO_DATA field.
OBS_DATA	*EO_DATA_1* *EO_DATA_2 etc.*	*Details of each observation, including biological.* EOREP EO_DATA_2 etc... Long records are carried over into the next field.
LITERATURE	*BESTSOURCE*	❖ *SOURCE - LITERATURE* *Literature source for specific observation.* ❖ *EOREP - BESTSOURCE* *The best source of information for the EOREP.*
	SPECIMEN	*Specimen or voucher information.*
	MAPSHEET	*USGS 1:24000 state quad code.*
	DIRECTIONS_1 *DIRECTIONS_2 etc.*	*Directions to, or description of, the location.* EOREP DIRECTIONS_2 etc... Long records are carried over into the next field.
	GEN_DESC_1 *GEN_DESC_2 etc.*	*General habitat description for the location.* EOREP GEN_DESC_2 etc... Long records are carried over into the next field.
		Documentation comments.
	MIN_ELEV	*Minimum elevation in feet.*
	MAX_ELEV	*Maximum elevation in feet.*
	MANAGED_BY	*Land management area (i.e. agency land ownership).*
EO_ID	*EO_ID*	*Identification number for the Element Occurrence (EO).*

Biotics SOURCE	Biotics EOREP	DEFINITION
EO_NUM	*EO_NUM*	*Element Occurrence number for the Element.*
INDEPEN_SF		*Independent Source Feature:* *Y - Yes, Source Feature did not qualify for inclusion in an EOREP.* *N - No, Source Feature is part of an EOREP.*
SOURCE_ID		*Identification number for the Source Feature in Biotics.*
ID_CONFIRM	*ID_CONFIRM*	*Indicates whether identification has been confirmed by a reliable individual:* *Y - Yes* *N - No* *?/Q - Questionable* *U - Unknown*
BUFFERDIST *DIST_UNIT*	*PRECISION* *ACCURACY*	❖ *SOURCE - BUFFERDIST* *Estimated accuracy of the location given as a buffered distance (represented in the EOREP shapefile).* ❖ *SOURCE - DIST_UNIT* *Unit of distance measure for BUFFERDIST.* ❖ *EOREP - PRECISION* *Estimated precision of the data (old method, carried over from previous system; as records are updated in Biotics this value is deleted and the next field is populated):* *G - Low - within 7.5 km* *M - Medium - within 700* *S - High - within 20 m* ❖ *EOREP – ACCURACY* *Estimated accuracy of the data (new method, populated as data are updated in Biotics):* *Very High (>95%)* *High (>80%, <=95%)* *Medium (>20%, <=80%)* *Low (>0%, <=20%)* *Unknown*
	EO_RANK	*EO Rank; an estimate of the relative value or viability of the Element Occurrence.*
DESCRIPTOR	*EO_TYPE*	*A brief description of the Source Feature or Element Occurrence.* *When the DESCRIPTOR field in Biotics SOURCE files is populated with "HDMS DEFAULT CONVERSION VALUES", use the EOREP file to view data by cross-referencing EO_ID. We are currently in transition from the old BCD methodology to Biotics.*
	SURVEYTYPE	*Survey type.*
	SIZE_OF_EO	*Size of EO in acres unless otherwise noted.*
	INVENT_COM	*Inventory comments.*

SHAPEFILE	AREA	ELEM_TYPE	ELCODE	SNAME
source_pt	Request	Amphibian	AAAAA01140	Ambystoma tigrinum
source_pt	Buffer	Amphibian	AAABH01170	Rana pipiens
source_pt	Request	Amphibian	AAABH01170	Rana pipiens
eorep	Buffer	Bird	ABNKC19120	Buteo regalis
source_line	Buffer	Bird	ABNKC19120	Buteo regalis
source_line	Request	Bird	ABNKC19120	Buteo regalis
source_line	Buffer	Bird	ABNKC22010	Aquila chrysaetos
source_line	Request	Bird	ABNKC22010	Aquila chrysaetos
source_pt	Buffer	Bird	ABNLC12010	Centrocercus urophasianus
source_line	Request	Bird	ABNLC12010	Centrocercus urophasianus
source_line	Buffer	Bird	ABNMK01010	Grus canadensis
data_sensitive	Buffer	Bird	ABNNB03100	Charadrius montanus
source_pt	Buffer	Bird	ABNNB03100	Charadrius montanus
source_pt	Buffer	Bird	ABNSB10010	Athene cunicularia
source_line	Request	Bird	ABNSB10010	Athene cunicularia
source_pt	Request	Bird	ABNSB10010	Athene cunicularia
source_line	Buffer	Bird	ABNSB13040	Asio flammeus
source_pt	Buffer	Bird	ABNSB13040	Asio flammeus
source_pt	Request	Bird	ABNSB13040	Asio flammeus
source_line	Buffer	Bird	ABPBK04010	Oreoscoptes montanus
source_pt	Buffer	Bird	ABPBK04010	Oreoscoptes montanus
source_line	Request	Bird	ABPBK04010	Oreoscoptes montanus
source_pt	Request	Bird	ABPBK04010	Oreoscoptes montanus
source_line	Buffer	Bird	ABPBR01030	Lanius ludovicianus
source_pt	Buffer	Bird	ABPBR01030	Lanius ludovicianus
source_line	Request	Bird	ABPBR01030	Lanius ludovicianus
source_line	Request	Bird	ABPBX94030	Spizella pallida
source_line	Buffer	Bird	ABPBX94040	Spizella breweri
source_pt	Buffer	Bird	ABPBX94040	Spizella breweri
source_line	Request	Bird	ABPBX94040	Spizella breweri
source_pt	Request	Bird	ABPBX94040	Spizella breweri
source_line	Buffer	Bird	ABPBX97020	Amphispiza belli
source_line	Buffer	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Buffer	Bird	ABPBXA0020	Ammodramus savannarum
source_line	Request	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Request	Bird	ABPBXA0020	Ammodramus savannarum
source_pt	Buffer	Bird	ABPBXA6010	Calcarius mccownii
source_line	Request	Bird	ABPBXA6010	Calcarius mccownii
source_pt	Request	Bird	ABPBXA6010	Calcarius mccownii
source_pt	Buffer	Bird	ABPBXA6040	Calcarius ornatus
source_line	Request	Bird	ABPBXA6040	Calcarius ornatus
source_pt	Request	Bird	ABPBXA6040	Calcarius ornatus
eorep	Request	Mammal	AMABA01130	Sorex nanus
source_pt	Request	Mammal	AMABA01130	Sorex nanus
eorep	Request	Mammal	AMACC05030	Lasiurus cinereus
source_pt	Request	Mammal	AMACC05030	Lasiurus cinereus
source_pt	Buffer	Mammal	AMAJA03030	Vulpes velox
data_sensitive	Request	Mammal	AMAJA03030	Vulpes velox
source_pt	Request	Mammal	AMAJA03030	Vulpes velox
source_pt	Buffer	Mammal	AMAJF02040	Mustela nigripes
eorep	Buffer	Flowering Plant	PDFAB0F150	Astragalus barrii

source_pt Buffer Flowering Plant PDFAB0F150 Astragalus barrii

COMNAME	G_RANK	S_RANK	USFWS_ESA
Tiger salamander	G5	S4	
Northern leopard frog	G5	S3	
Northern leopard frog	G5	S3	
Ferruginous hawk	G4	S4B,S5N	
Ferruginous hawk	G4	S4B,S5N	
Ferruginous hawk	G4	S4B,S5N	
Golden eagle	G5	S3B	
Golden eagle	G5	S3B	
Greater sage grouse	G4	S4	Petitioned
Greater sage grouse	G4	S4	Petitioned
Sandhill crane	G5	S3B,S5N	
Mountain plover	G2	S2	Listing Denied
Mountain plover	G2	S2	Listing Denied
Burrowing owl	G4	S3	
Burrowing owl	G4	S3	
Burrowing owl	G4	S3	
Short-eared owl	G5	S2	
Short-eared owl	G5	S2	
Short-eared owl	G5	S2	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Sage thrasher	G5	S5	
Loggerhead shrike	G4	S3	
Loggerhead shrike	G4	S3	
Loggerhead shrike	G4	S3	
Clay-colored sparrow	G5	S3B	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Brewer's sparrow	G5	S5	
Sage sparrow	G5	S3	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
Grasshopper sparrow	G5	S4	
McCown's longspur	G4	S2	
McCown's longspur	G4	S2	
McCown's longspur	G4	S2	
Chestnut-collared longspur	G5	S1	
Chestnut-collared longspur	G5	S1	
Chestnut-collared longspur	G5	S1	
Dwarf shrew	G4	S4	
Dwarf shrew	G4	S4	
Hoary bat	G5	S4	
Hoary bat	G5	S4	
Swift fox	G3	S2	Listing Denied
Swift fox	G3	S2	Listing Denied
Swift fox	G3	S2	Listing Denied
Black-footed ferret	G1	S1	Endangered (E, EXPN)
Barr's Milkvetch	G3	S3	

Barr's Milkvetch G3 S3

AGENCYSTAT	TRACKSTAT
WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3	Y
	W
	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2	Y
WGFD CWCS, WGFD NSS3	W
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2	Y
WY BLM SSL, S-USFS R2	Y
WY BLM SSL, S-USFS R2	Y
	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	W
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WGFD CWCS, WGFD NSS3	W
WGFD CWCS, WGFD NSS3	W
WGFD CWCS, WGFD NSS4	W
WGFD CWCS, WGFD NSS4	W
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4	Y
WGFD CWCS, WGFD NSS1	Y
S-USFS R2	Y

ADDENDUM D9B:

WILDLIFE SPECIES LIST,
NICHOLS RANCH ISR PROJECT

Table D9B-1 Wildlife Species That Were Observed or Have the Potential to Occur Within or in the Vicinity of the Nichols Ranch ISR Project Area.

Common Name	Scientific Name	Sources[1]	
		A[2]	B
MAMMALS			
Merriam's shrew	*Sorex merriami*	B	
Dusky shrew	*Sorex monticolus*	B	
Western small-footed myotis	*Myotis ciliolabrum*	h	
Long-eared myotis	*Myotis evotis*	O	
Little brown myotis	*Myotis lucifugus*	O	
Long-legged myotis	*Myotis volans*	B	
Hoary bat	*Lasiurus cinereus*	h	
Silver-haired bat	*Lasionycteris noctivagans*	O	
Big brown bat	*Eptesicus fuscus*	h	
Townsend's big-eared bat	*Plecotus townsendii*	O	
Desert cottontail	*Sylvilagus auduboni*	B	X
Mountain cottontail	*Sylvilagus nutallil*	b	?
Black-tailed jackrabbit	*Lepus californicus*	B	
White-tailed jackrabbit	*Lepus townsendii*	B	X
Least chipmunk	*Tamias minimus*	B	
Wyoming ground squirrel	*Spermophilus elegans*	B	
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	B	X
Yellow-bellied marmot	*Marmota flaviventris*	B	
White-tailed prairie dog	*Cynomys leucurus*	B	
Black-tailed prairie dog	*Cynomys ludovicianus*	B	X
Eastern fox squirrel	*Sciurus niger*	b	
Northern pocket gopher	*Thomomys talpoides*	h, B	
Olive-backed pocket mouse	*Perognathus fasciatus*	B	
Silky pocket mouse	*Perognathus flavus*	b	
Ord's kangaroo rat	*Dipodomys ordii*	B	
Beaver	*Castor canadensis*	B	
Western harvest mouse	*Reithrodontomys megalotis*	h, B	
Deer mouse	*Peromyscus maniculatus*	B	
White-footed mouse	*Peromyscus leucopus*	B	
Northern grasshopper mouse	*Onychomys leucogaster*	B	
Bush-tailed woodrat	*Neotoma cinerea*	B	
Southern red-backed vole	*Clethrionomys gapperi*	B	
Prairie vole	*Microtus ochrogaster*	B	
Meadow vole	*Microtus pennsylvanicus*	h	
Water vole	*Microtus richardsoni*	b	
House mouse	*Mus musculus*	B	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Porcupine	*Erethizon dorsatum*	B	X
Coyote	*Canis latrans*	B	X
Swift fox	*Vulpes velox*	b	
Red fox	*Vulpes vulpes*	B	
Gray fox	*Urocyon cinereoargenteus*	B	
Racoon	*Procyon lotor*	B	
Long-tailed weasel	*Mustela frenata*	b	
Black-footed ferret	*Mustela nigripes*	h	
Mink	*Mustela vison*	b	
Badger	*Taxidea taxus*	B	X
Western spotted skunk	*Spilogale gracilis*	b	
Eastern spotted skunk	*Spilogale putorius*	b	
Striped skunk	*Mephitis mephitis*	B	
Mountain lion	*Felis concolor*	B	
Bobcat	*Felis rufus*	B	
Elk	*Cervas elaphus*	B	
Mule deer	*Odocoileus hemionus*	B	X
White-tailed deer	*Odocoileus virginianus*	B	
Pronghorn	*Antilocapra americana*	B	X
Bighorn sheep	*Ovis canadensis*	h	
BIRDS			
Common loon	*Gavia immer*	O	
Eared grebe	*Podiceps nigricollis*	O	
Pied-billed grebe	*Podilymbus podiceps*	B	
Western grebe	*Aechmophorus occidentalis*	O	
Horned grebe	*Podiceps auritus*	O	
Clark's grebe	*Aechmophorus clarkii*	O	
American white pelican	*Pelecanus erythrorhynchos*	O	
Double-crested cormorant	*Phalacrocorax auritus*	B, O	
American bittern	*Botaurus lentiginosus*	O	
Great blue heron	*Ardea herodias*	B	
Cattle egret	*Bubulcus ibis*	O	
Black-crowned night-heron	*Nycticorax nycticorax*	O	
White-faced ibis	*Plegadis chihi*	O	
Tundra swan	*Cygnus columbianus*	O	
Trumpeter swan	*Cygnus buccinator*	O	
Snow goose	*Chen caerulescens*	O	
Canada goose	*Branta canadensis*	B	
Wood duc	*Aix sponsa*	O	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Green-winged teal	*Anas crecca*	B	
Mallard	*Anas platyrhynchos*	B	X
Northern pintail	*Anas acuta*	B	
Blue-winged teal	*Anas discors*	B	
Cinnamon teal	*Anas cyanoptera*	B	
Northern shoveler	*Anas clypeata*	B	
Gadwall	*Anas strepera*	B	
American wigeon	*Anas americana*	B	
Canvasback	*Aythya valisineria*	O	
Redhead	*Aythya americana*	O	
Ring-necked duck	*Aythya collaris*	O	
Lesser scaup	*Aythya affinis*	O	
Common goldeneye	*Bucephala clangula*	O	
Barrow's goldeneye	*Bucephala islandica*	O	
Bufflehead	*Bucephala albeola*	O	
Hooded merganser	*Lophodytes cucullatus*	O	
Common merganser	*Mergus merganser*	O	
Red-breasted merganser	*Mergus serrator*	O	
Ruddy duck	*Oxyura jamaicensis*	O, b	
Turkey vulture	*Cathartes aura*	b, O	
Osprey	*Pandion haliaetus*	O	
Bald eagle	*Haliaeetus leucocephalus*	B	X
Northern harrier	*Circus cyaneus*	B	
Sharp-shinned hawk	*Accipiter striatus*	O	
Cooper's hawk	*Accipiter cooperii*	b, O	
Swainson's hawk	*Buteo swainsoni*	B	
Red-tailed hawk	*Buteo jamacensis*	B	X
Ferruginous hawk	*Buteo regalis*	B	
Rough-legged hawk	*Buteo lagopus*	O	X
Golden eagle	*Aquila chrysaetos*	B	X
American kestrel	*Falco sparverius*	B	X
Merlin	*Falco columbarius*	B	
Peregrine falcon	*Falco peregrinus*	O	
Prairie falcon	*Falco mexicanus*	B	X
Gray partridge	*Perdix perdix*	O, B	X
Chukar	*Alectoris chukar*	B	
Ring-necked pheasant	*Phasianus colchicus*	B	
Greater sage-grouse	*Centrocercus urophasianus*	B	X
Sharp-tailed grouse	*Tympanuchus phasianellus*	O, B	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Wild turkey	*Meleagris gallopavo*	B	
Sora	*Porzana carolina*	O	
American coot	*Fulica americana*	B	
Sandhill crane	*Grus canadensis*	B	
Black-bellied plover	*Pluvialis squatarola*	O	
Semipalmated plover	*Charadrius semipalmatus*	O	
Killdeer	*Charadrius vociferus*	B	
Mountain plover	*Charadrius montanus*	O, B	
Black-necked stilt	*Himantopus mexicanus*	O	
American avocet	*Recurvirostra americana*	B	
Greater yellowlegs	*Tringa melanoleuca*	O	
Lesser yellowlegs	*Tringa flavipes*	O	
Solitary sandpiper	*Tringa solitaria*	O	
Willet	*Catoptrophorus semipalmatus*	B, O	
Spotted sandpiper	*Actitis macularia*	B	
Upland sandpiper	*Bartramia longicauda*	B	
Whimbrel	*Numenius phaeopus*	O	
Long-billed curlew	*Numenius americanus*	O	
Marbled godwit	*Limosa fedoa*	O	
Sanderling	*Calidris alba*	O	
Semipalmated sandpiper	*Calidris pusilla*	O	
Western sandpiper	*Calidris mauri*	O	
Least sandpiper	*Calidris minutilla*	O	
White-rumped sandpiper	*Calidris fuscicollis*	O	
Baird's sandpiper	*Calidris bairdii*	O	
Pectoral sandpiper	*Calidris melanotos*	O	
Stilt sandpiper	*Calidris himantopus*	O	
Long-billed dowitcher	*Limnodromus scolopaceus*	O	
Wilson's phalarope	*Phalaropus tricolor*	b, B	
Red-necked phalarope	*Phalaropus lobatus*	O	
Franklin's gull	*Larus pipixcan*	O	
Bonapartes gull	*Larus philadelphia*	O	
Ring-billed gull	*Larus delawarensis*	O	
California gull	*Larus californicus*	O	
Herring gull	*Larus argentatus*	O	
Caspian tern	*Sterna caspia*	O	
Common tern	*Sterna hirundo*	O	
Forster's tern	*Sterna forsteri*	O	
Black tern	*Chlidonias niger*	O, b	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Rock dove	*Columba livia*	b, B	
Mourning dove	*Zenaida macroura*	B	
Black-billed cuckoo	*Coccyzus erythropthalmus*	O	
Yellow-billed cuckoo	*Coccyzus americanus*	O	
Barn owl	*Tyto alba*	O	
Great horned owl	*Bubo virginianus*	B	X
Snowy owl	*Nyctea scandiaca*	O	
Burrowing owl	*Athene cunicularia*	B	
Long-eared owl	*Asio otus*	O, B	X
Short-eared owl	*Asio flammeus*	O, B	
Northern saw-whet owl	*Aegolius acadicus*	O	
Common nighthawk	*Chordeiles minor*	b, B	
Common poorwill	*Phalaenoptilus nuttallii*	O, b	
Chimney swift	*Chaetura pelagica*	O	
White-throated swift	*Aeronautes saxatalis*	O	
Broad-tailed hummingbird	*Selasphorus platycercus*	O	
Rufous hummingbird	*Selasphorus rufus*	O	
Belted kingfisher	*Ceryle alcyon*	b, B	
Lewis' woodpecker	*Melanerpes lewis*	O	
Red-headed woodpecker	*Melanerpes erythrocephalus*	O, B	
Red-naped sapsucker	*Sphyrapicus nuchalis*	O	
Williamson's sapsucker	*Sphyrapicus thyroideus*	O	
Downy woodpecker	*Picoides pubescens*	b, B	
Hairy woodpecker	*Picoides villosus*	b, O	
Northern flicker	*Colaptes auratus*	B	
Olive-sided flycatcher	*Contopus cooperi*	B	
Western wood-pewee	*Contopus sordidulus*	b, B	
Willow flycatcher	*Empidonax traillii*	O, B	
Least flycatcher	*Empidonax minimus*	O	
Dusky flycatcher	*Empidonax oberholseri*	O	
Cordilleran flycatcher	*Empidonax occidentallis*	O	
Say's phoebe	*Sayornis saya*	B	
Western kingbird	*Tyrannus verticalis*	b, B	
Eastern kingbird	*Tyrannus tyrannus*	b, B	
Horned lark	*Eremophila alpestris*	b, B	X
Tree swallow	*Tachycineta bicolor*	B, O	
Ash-throated flycatcher	*Myiarcher cinerascens*	O	
Violet-green swallow	*Tachycineta thalassina*	B	
Northern rough-winged swallow	*Stelgidopteryx serripennis*	b	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Bank swallow	*Riparia riparia*	O	
Cliff swallow	*Hirundo pyrrhonota*	B	
Barn swallow	*Hirundo rustica*	b, B	
Gray jay	*Perisoreus canadensis*	O	
Blue jay	*Cyanocitta cristata*	O	
Pinyon jay	*Gymnorhinus cyanocephalus*	b, O	
Clark's nutcracker	*Nucifraga columbiana*	B, O	
Black-billed magpie	*Pica pica*	B	X
American crow	*Corvus brachyrhynchos*	b, O	
Common raven	*Corvus corax*	O	
Black-capped chickadee	*Parus atricapillus*	B	
Mountain chickadee	*Poecile gambeli*	b, O	
Red-breasted nuthatch	*Sitta canadensis*	O, B	
White-breasted nuthatch	*Sitta carolinensis*	O	
Pygmy nuthatch	*Sitta pygmaea*	O	
Rock wren	*Salpinctes obsoletus*	b, B	
Canyon wren	*Catherpes mexicanus*	b	
House wren	*Troglodytes aedon*	B	
Bewick's wren	*Thyromanes bewickii*	O	
Marsh wren	*Cistothorus palustris*	B	
Ruby-crowned kinglet	*Regulus calendula*	O	
Western bluebird	*Sialia mexicana*	B	
Mountain bluebird	*Sialia currucoides*	B	
Townsend's solitaire	*Myadestes townsendi*	O	
Veery	*Catharus fuscescens*	O	
Swainson's thrush	*Catharus ustulatus*	O, b	
Hermit thrush	*Catharus guttatus*	O	
American robin	*Turdus migratorius*	B	
Gray catbird	*Dumetella carolinensis*	B, O	
Northern mockingbird	*Mimus polyglottos*	O, B	
Sage thrasher	*Oreoscoptes montanus*	b, B	
Brown thrasher	*Toxostoma rufum*	b	
American pipit	*Anthus rubescens*	O	
Bohemian waxwing	*Bombycilla garrulus*	O	
Cedar waxwing	*Bombycilla cedrorum*	b, O	
Northern shrike	*Lanius excubitor*	O	
Loggerhead shrike	*Lanius ludovicianus*	B	
European starling	*Sturnus vulgaris*	b, B	
Solitary vireo	*Vireo solitarius*	b, O	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Warbling vireo	*Vireo gilvus*	b, O	
Orange-crowned warbler	*Vermivora celata*	B, O	
Yellow warbler	*Dendroica petechia*	b, B	
Yellow-rumped warbler	*Dendroica coronata*	O, B	
Chestnut-sided warbler	*Dendroica pennsylvanica*	O	
American redstart	*Setophaga ruticilla*	b, O	
Ovenbird	*Seiurus aurocapillus*	O	
Macgillivray's warbler	*Oporornis tolmiei*	O	
Common yellowthroat	*Geothlypis trichas*	b, B	
Wilson's warbler	*Wilsonia pusilla*	O	
Yellow-breasted chat	*Icteria virens*	b	
Western tanager	*Piranga ludoviciana*	b	
Rose-breasted grosbeak	*Pheucticus ludovicianus*	O	
Black-headed grosbeak	*Pheucticus melanocephalus*	b, B	
Lazuli bunting	*Passerina amoena*	O, b	
Dickcissel	*Spiza americana*	O	
Green-tailed towhee	*Pipilo chlorurus*	B, b	
Spotted towhee	*Pipilo maculatus*	b, O	
American tree sparrow	*Spizella arborea*	O	
Chipping sparrow	*Spizella passerina*	b, B	
Clay-colored sparrow	*Spizella pallida*	O	
Brewer's sparrow	*Spizella breweri*	b, B	X
Field sparrow	*Spozella pusilla*	O	
Vesper sparrow	*Pooecetes gramineus*	B	
Lark sparrow	*Chondestes grammacus*	B	
Lark bunting	*Calamospiza melanocorys*	B	
Savannah sparrow	*Passerculus sandwichensis*	O, b	
Grasshopper sparrow	*Ammodramus savannarum*	b, B	
Baird's sparrow	*Ammodramus bairdii*	b*	
Fox sparrow	*Passerella iliaca*	O	
Sage sparrow	*Amphispiza belli*	O, B	
Song sparrow	*Melospiza melodia*	b	
Lincoln's sparrow	*Melospiza lincolnii*	B, O	
White-throated sparrow	*Zonotrichia albicollis*	O	
White-crowned sparrow	*Zonotrichia leucophrys*	O	
Harris' sparrow	*Zonotrichia querula*	O	
Dark-eyed junco	*Junco hyemalis*	O, B	
McCown's longspur	*Calcarius mccownii*	b, B	
Lapland longspur	*Calcarius lapponicus*	O	

Table D9B-1 (Continued)

Common Name	Scientific Name	Sources[1]	
		A[2]	B
Chestnut-collared longspur	*Calcarius ornatus*	b	
Snow bunting	*Plectrophenax nivalis*	O	
Bobolink	*Dolichonyx oryzivorus*	O	
Red-winged blackbird	*Agelaius phoeniceus*	B	
Western meadowlark	*Sturnella neglecta*	b, B	
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	B, O	
Brewer's blackbird	*Euphagus cyanocephalus*	b, B	
Rusty blackbird	*Euphagus carolinus*	O	
Common grackle	*Quiscalus quiscula*	b, B	
Brown-headed cowbird	*Molothrus ater*	O, B	
Bullock's oriole	*Icterus bullockii*	B	
Gray-crowned rosy-finch	*Leucosticte tephrocotis*	O	
Cassin's finch	*Carpodacus cassinii*	O	
House finch	*Carpodacus mexicanus*	O	
Red crossbill	*Loxia curvirostra*	b, B	
Common redpoll	*Carduelis flammea*	O	
Pine sisken	*Carduelis pinus*	O, b	
American goldfinch	*Carduelis tristis*	B, b	
Evening grosbeak	*Coccothraustes vespertinus*	O	
House sparrow	*Passer domesticus*	B	
REPTILES AND AMPHIBIANS			
Tiger salamander	*Ambystoma tigrinum*	O	
Plains spadefoot	*Scaphiopus bombifroms*	O*	
Great plains toad	*Bufo cognatus*	O	
Woodhouse's toad	*Bufo woodhousei woodhousei*	O	
Northern leopard frog	*Rana pipiens*	O	
Western painted turtle	*Chrysemys picta belli*	O	
Greater short-horned lizard	*Phrynosoma hernandesi*	H*	
Plains hog nose snake	*Heterodon nasicus nasicus*	O	
Prairie rattlesnake	*Crotalus viridis viridis*	O, H*	X
Bullsnake	*Pituophis melanoleucas sayi*	O	X
Wandering garter snake	*Thamnophis elegans vagrans*	O	
Eastern yellowbelly racer	*Coluber constrictor flaviventris*	H*	X

[1] A = Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming (Cerovski 2004).
B = TRC Environmental Corporation field observations.

[2] **For Mammals:**
B = Nest, dependent young, juvenile animals, lactating or post-lactation females, or males in breeding condition were observed.

Table D9B-1 (Continued)

b = Animals were observed and, due to limited mobility, breeding is assumed (bats and large ungulates are highly mobile and are not automatically placed in this category).
O = The species has been observed but, due to the mobility of the species' group and lack of factors listed under (B), breeding cannot be assumed (applies to bats and large ungulates).
h = Historical record of occurrence before 1965. No recent data to suggest occurrence.

For Birds:

B = Nest or young dependent upon parent birds was observed.
b = Circumstantial evidence of nesting.
O = The species has been observed, but there was no evidence of nesting. The observation may have been recorded during any season of the year, but observations are most likely to correspond with seasonal occurrences.
h = Historical record with no indication of nesting.

For Amphibians and Reptiles:

O = The species has been observed but, due to the lack of factors listed under (B) or (b), breeding cannot be assumed.
h = Historical record of occurrence.
* = Record was obtained from the University of Wyoming Museum.

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