LOST CREEK ISR, LLC

Lost Creek Project

WDEQ-LQD Permit Application

VOLUME 8d

LC East Amendment

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APPENDIX D7

LOST CREEK EAST AMENDMENT AREA
2012 BASELINE SOIL ASSESSMENT

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ADDENDUM D7

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ADDENDA

D7-1 SOILS

D7-1.1 INTRODUCTION

This report presents baseline information on the soils occurring within the Lost Creek ISR, LLC, Lost Creek East (LCE) Amendment Area. This will be an amendment to WDEQ Permit to Mine No. 788. NRC license is Number SUA-1598. Baseline soils inventories were used to delineate the soils resources within the LCE Amendment Area, as well as determine topsoil salvage depths and ultimately replacement depths over the entire amendment area. The project area is located approximately 50 miles northwest of Rawlins in Sweetwater County, Wyoming, in all or portions of Sections 1, 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 27, 28 and 29 of T25N, R92W.

D7-1.2 METHODS

D7-1.2.1 Review of Existing Literature

The soils in this portion of Sweetwater County have not yet been mapped to an Order 3 scale by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) (Martin 2013). However, in a 2007 Lost Creek ISR, LLC, Environmental Report, adjacent to the LCE Amendment Area, soils were mapped to an Order 2 scale as Typic Torriorthent, loamy and fine loamy, and fine loamy over sandy, mixed mesic. Existing information regarding soils in mapped portions of Sweetwater County is available in both electronic and hard copy formats from the NRCS. The NRCS has also centralized dissemination of typical soil series descriptions. This information is available on the internet at www.nrcs.usda.gov.

D7-1.2.2 2012 Project Participants

BKS Environmental Associates, Inc. (BKS) of Rock Springs, Wyoming, performed the 2012 soil survey fieldwork, mapping, and compiled the resulting report. Aerial imagery, for all maps used for this project, was obtained from USDA. Drafting of the final soils map was completed by BKS. All soil samples were taken to Energy Labs, Inc. in Gillette, Wyoming.

D7-1.2.3 Soil Survey

Field mapping was conducted according to techniques and procedures outlined in the National Cooperative Soil Survey. Wyoming Department of Environmental Quality (WDEQ) Land Quality Division (LQD) Guideline 1 (August 1994 Revision) was used as a guide during all phases of the study.

An Order 2 soil survey was conducted in October of 2012. Actual soil boundaries were identified in the field by exposing soil profiles to determine the nature and extent of soil series within the LCE Amendment Area. The soil boundaries were delineated on a 2001 NAIP orthophoto with a relative scale of 1 inch = 500 feet. Refer to Table D7-1.1 for Soil Map Unit Acreages and Total LCE Amendment Area Acreage.

A total of 5,724.34 acres were included in the final soil mapping of the LCE Amendment Area. Overall, there were 25 verification points in addition to 18 sample points which had profiles written for them. The eighteen sampled locations were sent to the laboratory for analysis, which resulted in a total of 63 soil samples. Refer to Table D7-1.3 for Soil Sample Locations within the LCE Amendment Area.

D7-1.2.4 Field Sampling

Sampling of soil series identified within the LCE Amendment Area generally followed WDEQ-LQD Guideline 1 recommendations of three sampled pedons for series encompassing greater than 160 acres, two sampled pedons for series encompassing between 40 and 160 acres, and one sampled pedon for series encompassing less than 40 acres. Please see Table D7-1.2 for the Soil Series Sample Summary within the LCE Amendment Area.

All soil samples were collected with a Giddings truck mounted auger or hand auger to paralithic contact or a maximum depth of 60", whichever was shallower. Sampled profiles were described in the field, to the extent possible, by the physical and chemical nature of each profile horizon. Backhoe pits were not utilized for soil sampling. Refer to Addendum D7-1-F for Site Photographs.

Sample locations were identified on a base map, and global positioning system (GPS) points were collected with a hand-held Garmin GPS unit. Soil samples were placed in clean, labeled, polyethylene plastic bags, and sealed to limit sample contamination. Samples were kept as cool as possible, but not stored on ice. Samples were delivered to Energy Labs in Gillette, Wyoming.

D7-1.2.5 Laboratory Analysis

Samples were placed into lined aluminum pans to air dry. Coarse fragments were measured with a 10 mesh screen prior to grinding. The entire sample was hand ground to pass a 10 mesh screen. An approximate 20 ounce subsample was obtained through splitting with a series of riffle splitters and subsequently analyzed. A second subsample was maintained in storage at Energy Labs. Approximately five percent of the samples were run for duplicate analysis.

Actual laboratory analysis followed the methodology outlined in WDEQ-LQD Guideline 1. In general, samples were processed as soon as possible after receipt. All analytical data is found in Addendum D7-1-D Soil Laboratory Analysis.

D7-1.3 RESULTS AND DISCUSSION

D7-1.3.1 Soil Survey - General

The soils occurring within the LCE Amendment Area are typical of the semi-arid grasslands of the western United States. Due to prevailing climate and vegetation conditions, organic matter is accumulated slowly and is confined primarily to the surface horizon(s), resulting in light-coloration throughout the profile.

General topography of the area includes upland ridges, flat or gently sloping depressional areas, valley bottoms, and rolling hills. The soils occurring throughout the LCE Amendment Area were generally sandy loam textured. The soils varied in depth to paralithic material, ranging from 6 inches to greater than 60 inches. The majority of the soils were formed in slopewash alluvium weathered from sandstone and shale as well as siltstone.

D7-1.3.2 Soil Mapping Unit Interpretation

The primary purpose of the 2012 baseline soils inventory was to characterize the soils within the LCE Amendment Area in terms of topsoil salvage depths and related physical and chemical properties. Refer to Addendum D7-1-B and D7-1-C for Soil Map Unit Descriptions and Soil Series Descriptions, respectively. Map units and series descriptions were based on existing NRCS format but tailored to fit actual findings within the LCE Amendment Area.

D7-1.3.3 Analytical Results

Analyzed parameters, as defined in WDEQ-LQD Guideline 1, are in Addendum D7-1-D, Soil Laboratory Analysis. Laboratory soil texture analysis did not include percent fine sands. 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 for soils with fine sands. Where textures were not typical for the series (e.g., according to field observations or laboratory analysis), it was noted in the "Variation from Typical Series" section of the soil series descriptions.

D7-1.3.4 Evaluation of Soil Suitability as a Plant Growth Medium

Approximate salvage depths of each map unit series are presented in Table D7-1.6 and ranged from zero to 2.2 feet. Within the LCE Amendment Area, suitability of soil as a plant growth medium was generally limited by the physical factor of paralithic contact. Chemical limiting factors included saturation percentage, pH and calcium carbonate (as determined in the field). According to WDEQ-LQD Guideline 1, marginal material was found in 11 of the 18 sampled profiles. While a frequently occurring marginal parameter in samples was low saturation percentage, it should be noted that this value frequently was not significantly less (1 to 3%) than more suitable levels present in other samples. When combined with other (i.e. suitable) soils, these marginal quality soils will become "suitable" from a plant growth medium perspective.

Unsuitable material was found in none of the 18 sampled profiles. Marginal and unsuitable parameter information for the sampled profiles is identified in Table D7-1.4. A summary of trends in marginal and unsuitable parameters as it relates to soil series is found in Table D7-1.5.

D7-1.3.5 Topsoil Volume Calculations

Based on the 2012 baseline soils inventory, associated field observations, and subsequent chemical analysis, the weighted average depth of salvageable topsoil over the entire LCE Amendment Area was determined to be 1.6 feet. Refer to Table D7-1.6 for approximate soil salvage depths. Section OP 2.5 of the Operations Plan provides the approved topsoil management procedures, including topsoil salvage procedures, employed by LC ISR, LLC.

D7-1.3.6 Soil Erosion Properties and Impacts

Based on the soil mapping unit descriptions, the hazard for wind erosion ranges from moderate to severe and water erosion within the LCE Amendment Area varies from slight to moderate. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content. Given the generally sandy loam texture of the surface horizons throughout a majority of the LCE Amendment Area, the soils are slightly more susceptible to erosion from wind than water. See Table D7-1.7 for a Summary of Wind and Water Erosion Hazards within the LCE Amendment Area.

D7-1.3.7 Prime Farmland Assessment

The LCE Amendment Area was assessed for prime farmland by Jason Martin, the NRCS MLRS Leader, Rock Springs, Wyoming. Because this area has not yet been mapped by NRCS, there is no designation of Prime Farmland, though this does not necessarily mean that such does not exist within the project area. Refer to Addendum D7-1-E for the NRCS Letter of Non-Determination.

D7-1.4 REFERENCES

Lost Creek ISR, LLC. Lost Creek Project South-Central Wyoming. Environmental Report, Volume 1 of 3. October 2007, revised March 2008.

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ADDENDUM D7-1-A
TABLES

Table D7-1.1: Total LCE Amendment Study Area Acreage.

Map Symbol	Map Unit Description	Study Area Acreage	% Study Area Acreage
Ay	Almy sandy loam	2,614.96	45.68
Br	Bluerim sandy loam	1,975.59	34.51
By	Byrnie sandy loam	223.86	3.91
Cm	Carmody sandy loam	261.61	4.57
Cl	Clowers sandy loam	423.99	7.41
D	Disturbed land	13.93	0.24
Go	Goslin loamy sand	26.08	0.46
Tg	Teagulf sandy loam	184.32	3.22
	Total	**5,724.34**	**100.00**

Table D7-1.2: LCE Amendment Area Soil Series Sample Summary.

Soil Series	Number of Profiles to be Sampled for Chemical Analysis
Almy	3
Bluerim	3
Byrnie	3
Carmody	3
Clowers	3
Goslin	1
Teagulf	2
Total	**18**

Table D7-1.3: LCE Amendment Area Soil Sample Locations.

Soil Sample Number[1]	Map Unit Symbol	Soil Series
1	Tg	Teagulf
2	Br	Bluerim
6	Br	Bluerim
10	Cl	Clowers
12	Br	Bluerim
13	By	Byrnie
15	By	Byrnie
17	Tg	Teagulf
18	Br	Byrnie
101	Cm	Carmody
102	Cl	Clowers
103	Ay	Almy
104	Ay	Almy
105	Cm	Carmody
106	Go	Goslin
107	Ay	Almy
111	Cm	Carmody
113	Cl	Clowers

[1]Soil Sample Numbers correspond to those samples that were sent for lab analysis.
[2]Soil Sample Waypoint Numbers do not necessarily correspond to soil sample numbers, as several waypoints were taken with photographs of soil and landscape features that were not associated with lab analyses.

Table D7-1.4: LCE Amendment Area Marginal and Unsuitable Parameters within Sampled Profiles.

Soil Sample Number	Soils Series	Depth (in)	Marginal[1]	Unsuitable[1]
2	Bluerim	12-22	Saturation %	--
6	Bluerim	12-47	Saturation %	--
12	Bluerim	20-26	Saturation %	--
102	Clowers	14-24	Saturation %	--
103	Almy	20-46	Saturation %	--
104	Almy	10-45	Saturation %	--
		32-45	pH	
105	Carmody	12-35	Saturation %	--
106	Goslin	0-46	Saturation %	--
107	Almy	14-60	Saturation %	--
111	Carmody	0-12	Saturation %	--
113	Clowers	12-20	Saturation %	--

[1]Marginal and unsuitable parameters determined by comparing lab analysis with Table I-2 (Criteria to establish topsoil suitability) from WDEQ LQD Guideline 1.

Table D7-1.5: LCE Amendment Area Trends in Marginal and Unsuitable Parameters for Soil Series.

Soils Series	Unsuitable/Marginal Parameter[1]
Almy	Saturation %, pH
Bluerim	Saturation %
Carmody	Saturation %
Clowers	Saturation %
Goslin	Saturation %

[1]Marginal and unsuitable parameters determined by comparing lab analysis with Table I-2 (Criteria to establish topsoil suitability) from WDEQ LQD Guideline 1.

Table D7-1.6: LCE Amendment Area Approximate Soil Salvage Depths.

Map Symbol	Map Unit Description	Study Area Acreage[1]	Salvage Depth[2] (feet)	Total Volume of Topsoil[3]
Ay	Almy sandy loam	2,615.0	1.8	4707.0
Br	Bluerim sandy loam	1,975.6	1.4	2765.8
By	Byrnie sandy loam	223.9	0.6	134.3
Cm	Carmody sandy loam	261.6	0.8	209.3
Cl	Clowers sandy loam	424.0	2.2	932.8
D	Disturbed land	13.9	--	--
Go	Goslin loamy sand	26.1	0.0	0.0
Tg	Teagulf sandy loam	184.3	1.6	294.9
Average Salvage Depth of Amendment Area		---	**1.6[4]**	---
Total		**5,724.4**	---	**9,044.1**

[1]Found in Table D7-1.1 of this report.
[2]Found in Addendum D7-1-B of this report, under Topsoil Suitability.
[3]Calculated by multiplying permit acreage by salvage depth in feet, as shown in Table II-1 (Topsoil Volume Summary) of WDEQ LQD Guideline 1. Note that this calculation assumes total acreage to be disturbed, whereas ISR mine will not require all acres be disturbed.
[4]Calculated as the average of the weighted average salvage depths found in Addendum D7-1-B.

Table D7-1.7: LCE Amendment Area Wind and Water Erosion Hazards.

Map Unit Symbol	Soil Series	Water Erosion Hazard[1]	Wind Erosion Hazard[2]
Ay	Almy sandy loam	Moderate	Moderate
Br	Bluerim sandy loam	Moderate	Moderate
By	Byrnie sandy loam	Moderate	Moderate
Cm	Carmody sandy loam	Slight	Moderate
Cl	Clowers sandy loam	Moderate	Moderate
D	Disturbed land	Not rated	Not rated
Go	Goslin loamy sand	Moderate	Severe
Tg	Teagulf sandy loam	Moderate	Moderate

[1]Based on Kw factor of A horizon from the NRCS Soil Data Mart {http://soildatamart.nrcs.usda.gov/}
[2]Based on Wind Erodibility Group from the NRCS Soil Data Mart {http://soildatamart.nrcs.usda.gov/}.

ADDENDUM D7-1-B
SOIL MAP UNIT DESCRIPTIONS

Almy sandy loam[1]—Ay

This map unit consists of well drained soils that are very deep to fine red sandstone or shale. These soils formed in alluvium on alluvial fan aprons and fan piedmonts from fine interbedded sandstone or shale. Slopes range from 0 to 15 percent. Elevation ranges from 5,400 feet to 7,800 feet.

The following are the climatic conditions in which Almy soils generally form: the average annual precipitation is approximately 12 inches but ranges from 9 to 14 inches with over half falling in April, May, and June. The mean annual air temperature ranges from 42 to 46 degrees F. The frost-free season ranges from 60 to 110 days.

Permeability within the Almy soil is moderate or moderately slow; runoff is low on the gentler slopes and medium on the steeper slopes. The hazard of water and wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 21.48 inches based on an average of 2012 sample points. According to WDEQ-LQD Guideline 1, the following marginal parameters were found:

Soil Sample 103

- Saturation percentage, 20 to 46 inches

Soil Sample 104

- Saturation percentage, 10 to 45 inches
- pH, 32 to 45 inches

The 21.48-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Almy series.

[1]Map unit description based on 12/1999 NRCS information.

Bluerim sandy loam[2] – Br

The Bluerim map unit consists of moderately deep, well drained soils that formed in material weathered from calcareous sandy shale interbedded with arkosic sandstone. Slopes range from 3 to 20 percent. The Bluerim soil occurs on upland hillsides at elevations between 6,000 to 7,800 feet.

The following are the climatic conditions in which Bluerim soils generally form: the mean annual temperature is 34 to 45 degrees F. Precipitation is 10 to 14 inches. The growing season is 80 to 120 days but frost may occur in any month.

Permeability within the Bluerim soil is moderate. Runoff is moderately slow. The hazard of water and wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 16.5 inches based on an average of 2012 sample points. According to WDEQ-LQD Guideline 1, the following marginal parameter was found:

Soil Sample 2
- Saturation percentage, 12 to 22 inches

Soil Sample 6
- Saturation percentage, 12 to 47 inches

Soil Sample 12
- Saturation percentage, 20 to 26 inches

Additionally, calcium carbonate was observed to be a limiting factor in the field in some samples.

The 16.5-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Bluerim series.

[2]Map unit description based on 02/1999 NRCS information.

Byrnie sandy loam[3] – By

The Byrnie map unit consists very shallow and shallow, well drained soils that formed in slope alluvium over residuum derived from reddish colored sandstone. Slopes range from 2 to 60 percent. Byrnie soils are on are on gently sloping to very steep hills and ridges at elevations between 6,000 and 7,800 feet.

The following are the climatic conditions in which Byrnie soils generally form: average annual precipitation is about 12 inches but ranges 10 to 15 inches, with peak periods of precipitation occurring in the spring and early summer months. Mean annual air temperature is 40 to 45 degrees F. Frost-free period is 85 to 100 days.

Permeability within the Byrnie soil is moderately rapid. Runoff is medium to very rapid. The hazard of water or wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 7.56 inches based on an average of 2012 sample points. According to WDEQ-LQD Guideline 1, no marginal or unsuitable parameters were found. However, calcium carbonate content was observed to be a limiting factor in the field.

The 7.56-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Byrnie series.

[3]Map unit description based on 05/1999 NRCS information.

Carmody sandy loam[4] – Cm

This map unit consists of well to somewhat excessively drained soils that are moderately deep to siltstone. Slopes range from 2 to 45 percent. The Carmody soil formed in material weathered from calcareous siltstone or fine grained sandstone and are on uplands of the cold intermountain basins at elevations between 5,300 to 7,800 feet.

The following are the climatic conditions in which Carmody soils generally form: the mean annual precipitation ranges from 10 to 17 inches of which about half falls as snow or rain in April, May, and early June. The mean annual temperature is 39 to 45 degrees F., and the mean summer temperature is 58 to 65 degrees F. The frost-free season is 75 to 120 days depending upon aspect, elevation, and local air drainage.

Permeability within the Carmody soil is moderate or moderately rapid. Surface runoff is moderate to rapid. The hazard of water erosion is slight and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 9 inches based on an average of 2012 sample points. According to WDEQ-LQD Guideline 1, the following marginal parameters were found:

Soil Sample 105

- Saturation percentage, 12 to 35 inches

Soil Sample 111

- Saturation percentage, 0 to 12 inches

The 9-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Carmody series.

[4]Map unit description based on 03/2003 NRCS information.

Clowers[5] sandy loam- Cl

This map unit consists of deep, well and moderately well drained soils formed in mixed, calcareous alluvium. Slopes are typically 0 to 3 percent but may range up to 6 percent. Clowers soils formed in stratified, calcareous alluvium from mixed sources on alluvial flood plains and terraces at elevations from 6,300 to 7,400 feet.

The following are the climatic conditions in which Clowers soils generally form: the mean annual precipitation is about 8 inches and ranges from 5 to 9 inches with about half falling as rain or snow in April, May, and early June. The mean annual temperature is about 40 degrees F. and ranges from 38 to 44 degrees F. The frost-free season is estimated to range from 60 to 90 days depending upon elevation, aspect, and air drainage.

Permeability within the Clowers soil is moderate; runoff is slow through medium. The hazard of water and wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 26.40 inches based on an average of 2012 sample points. According to WDEQ-LQD Guideline 1, the following marginal parameters were found:

Soil Sample 102

- Saturation percentage, 14 to 24 inches

Soil Sample 113

- Saturation percentage, 12 to 20 inches

The 26.40-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Clowers map unit.

[5]Map unit description based on 03/2003 NRCS information.

Goslin[6] loamy sand- Go

This map unit consists of deep, well drained soils that formed in coarse textured alluvium derived from red sandstone. Slopes are 3 to 25 percent. Goslin soils formed in coarse textured alluvium derived from red sandstone on fan aprons, fan pediments, and alluvial terraces at elevations from 6,300 to 7,500 feet.

The following are the climatic conditions in which Goslin soils generally form: the mean annual precipitation is 9 to 14 inches with about half falling as snow or rain in April, May, and early June. The mean annual temperature is about 42 to 46 degrees F. The frost-free period is 60 to 90 days.

Permeability within the Goslin soil is moderately rapid. Surface runoff is moderate to medium to rapid, depending on slope. The hazard of water erosion is moderate, and the hazard of wind erosion is severe.

Topsoil Suitability

This map unit is an unsuitable source of topsoil based on 2012 sample points. According to WDEQ-LQD Guideline 1, the following marginal parameters were found:

Soil Sample 106

- Saturation percentage, 0 to 46

Additionally, calcium carbonate and high sand content were observed in the field to be limiting factors as well.

The 0-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goslin map unit.

[6]Map unit description based on 03/2003 NRCS information.

Teagulf[7] sandy loam- Tg

This map unit consists of moderately deep, well drained soils that formed in modified residuum and slopewash alluvium from calcareous sedimentary rocks. Slopes are 0 to 8 percent. Teagulf soils formed in modified residuum and slopewash alluvium from sedimentary rocks on nearly level and gently sloping erosional upland plains and alluvial fans at elevations from 6,000 to 7,300 feet.

The following are the climatic conditions in which Teagulf soils generally form: average annual precipitation is 6 to 9 inches. The mean annual air temperature is 38 degrees to 45 degrees F., and the mean summer air temperature is 61 degrees to 66 degrees F. The frost-free season is about 80 to 110 days.

Permeability within the Teagulf soil is moderately rapid. Surface runoff is slow to medium. The hazard of water and wind erosion is moderate.

Topsoil Suitability

This map unit is a suitable source of topsoil to 18.72 inches based on 2012 sample points. According to WDEQ-LQD Guideline 1, no marginal or unsuitable parameters were found.

The 18.72-inch salvage depth was used in Table D7-1.6 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Teagulf map unit.

[7]Map unit description based on 12/1999 NRCS information.

ADDENDUM D7-1-C
SOIL SERIES DESCRIPTIONS

ALMY SERIES

SOIL MAPPING UNIT: Ay

SOIL SAMPLE LOCATION: 103

The Almy series consists of very deep, well drained soils that formed in alluvium on alluvial fan aprons and fan piedmonts. Permeability is moderate. Slopes are 0 to 15 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 43 degrees F.

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

A--0 to 1 inches; brownish (5YR 5/3) fine sandy loam, dark reddish gray (5YR 4/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine tubular pores; slightly acid (pH 6.7); clear wavy boundary.

Bt—1 to 10 inches; brownish (5YR 5/3) sandy loam, dark reddish gray (5YR 4/2) moist, moderate thin platy structure parting to moderate fine subangular blocky; slightly hard, friable, sticky and plastic; common fine and medium roots; common fine tubular pores; common distinct clay films on faces of peds and lining pores; slightly acid (pH 6.7); clear wavy boundary.

Bw--10 to 20 inches; brown gray (5YR 5/3) sandy loam, dark reddish gray (5YR 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, very sticky and plastic; common fine and medium roots; common fine tubular pores; continuous clay films on faces of peds and lining pores; slightly alkaline (pH 7.2); clear wavy boundary.

BC/C1—20 to 26 inches; gray (5YR 5/1) sandy loam; gray brown (5YR 4/1) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and medium roots; few fine tubular pores; non-effervescent; slightly alkaline (pH 7.4); gradual wavy boundary.

C--26 to 46 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots to 40 inches; moderately alkaline (pH 7.7).

TYPE LOCATION: Sweetwater County, WY. Refer to waypoint 103 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
Depth to an accumulation of secondary calcium carbonates is 10 to 20 inches. The mean annual soil temperature is 42 to 46 degrees F. Rock fragments in the particle size control section range from 0 to 15 percent gravel. The moisture control section is usually dry. It is usually moist in April, May, and early June, and dry for 60 consecutive days during the 90 day period following the summer solstice.

The A horizon has hue of 10YR through 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4 dry and moist. Reaction is neutral through moderately alkaline.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 6 dry and moist. It is typically a clay loam but may be loam or sandy clay loam with 18 to 35 percent clay and less than 35 percent fine sandy or coarser. Reaction is mildly through strongly alkaline. EC is less than 8 mmhos.

The Bk horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 3 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam, sandy clay loam, or clay loam. Some pedons have sandy loam textures in the lower Bk. EC is less than 8 mmhos. Calcium carbonate ranges from 4 to 12 percent.

The C horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam or fine sandy loam. Calcium carbonate ranges from 2 to 10 percent. EC is less than 8 mmhos throughout. Reaction is moderately through very strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 20 inches and marginal to 26 inches, with the following marginal parameter:

- Saturation percentage, 20 to 46 inches

GEOGRAPHIC SETTING (according to official soil series description): Almy soils are on nearly level to moderately sloping alluvial fan aprons and fan piedmonts. Parent materials are weathered from interbedded, red, fine sandstone and shale. Slopes are both simple and complex and range from 0 to 15 percent. Elevation ranges from 5,400 feet to 7,800 feet. The mean annual precipitation is about 12 inches but ranges from 9 to 14 inches with over half falling in April, May, and June. The mean annual air temperature ranges from 42 to 46 degrees F. The frost-free season ranges from 60 to 110 days.

VARIATION FROM TYPICAL SERIES: Less alkaline and somewhat less clay than typical.

ALMY SERIES

SOIL MAPPING UNIT: Ay

SOIL SAMPLE LOCATION: 104

The Almy series consists of very deep, well drained soils that formed in alluvium on alluvial fan aprons and fan piedmonts. Permeability is moderate. Slopes are 0 to 15 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 43 degrees F.

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

A--0 to 1 inches; light brown (5YR 5/3) fine sandy loam, dark reddish gray (5YR 4/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine tubular pores; neutral (pH 6.9); clear wavy boundary.

Bt--1 to 10 inches; light brown (5YR 5/3) sandy loam, dark reddish gray (5YR 4/2) moist, moderate thin platy structure parting to moderate fine subangular blocky; slightly hard, friable, sticky and plastic; common fine and medium roots; common fine tubular pores; common distinct clay films on faces of peds and lining pores; neutral (pH 6.9); clear wavy boundary.

Bw--10 to 14 inches; reddish brown (5YR 5/3) sandy loam, dark reddish gray (5YR 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, very sticky and plastic; common fine and medium roots; common fine tubular pores; continuous clay films on faces of peds and lining pores; slightly alkaline (pH 7.3); clear wavy boundary.

BC/C1--14 to 18 inches; white gray (5YR 7/1) sandy loam; light gray (5YR 6/1) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and medium roots; few fine tubular pores; non-effervescent, slightly alkaline (pH 7.3); gradual wavy boundary.

C2--18 to 32 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots to 40 inches; moderately effervescent, calcium carbonate disseminated; moderately alkaline (pH 7.8).

C3--32 to 45 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots to 40 inches; moderately effervescent, calcium carbonate disseminated; strongly alkaline (pH 8.3).

TYPE LOCATION: Sweetwater County, WY. Refer to waypoint 104 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Depth to an accumulation of secondary calcium carbonates is 10 to 20 inches. The mean annual soil temperature is 42 to 46 degrees F. Rock fragments in the particle size control section range from 0 to 15 percent gravel. The moisture control section is usually dry. It is usually moist in April, May, and early June, and dry for 60 consecutive days during the 90 day period following the summer solstice.

The A horizon has hue of 10YR through 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4 dry and moist. Reaction is neutral through moderately alkaline.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 6 dry and moist. It is typically a clay loam but may be loam or sandy clay loam with 18 to 35 percent clay and less than 35 percent fine sandy or coarser. Reaction is mildly through strongly alkaline. EC is less than 8 mmhos.

The Bk horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 3 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam, sandy clay loam, or clay loam. Some pedons have sandy loam textures in the lower Bk. EC is less than 8 mmhos. Calcium carbonate ranges from 4 to 12 percent.

The C horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam or fine sandy loam. Calcium carbonate ranges from 2 to 10 percent. EC is less than 8 mmhos throughout. Reaction is moderately through very strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 10 inches and marginal to 18 inches, with the following marginal parameters:

- Saturation percentage, 10 to 45 inches
- pH, 32 to 45 inches

GEOGRAPHIC SETTING (according to official soil series description): Almy soils are on nearly level to moderately sloping alluvial fan aprons and fan piedmonts. Parent materials are weathered from interbedded, red, fine sandstone and shale. Slopes are both simple and complex and range from 0 to 15 percent. Elevation ranges from 5,400 feet to 7,800 feet. The mean annual precipitation is about 12 inches but ranges from 9 to 14 inches with over half falling in April, May, and June. The mean annual air temperature ranges from 42 to 46 degrees F. The frost-free season ranges from 60 to 110 days.

VARIATION FROM TYPICAL SERIES: Less alkaline and somewhat less clay than typical.

ALMY SERIES

SOIL MAPPING UNIT: Ay

SOIL SAMPLE LOCATION: 107

The Almy series consists of very deep, well drained soils that formed in alluvium on alluvial fan aprons and fan piedmonts. Permeability is moderate. Slopes are 0 to 15 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 43 degrees F.

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

A--0 to 3 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish gray (5YR 4/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine tubular pores; slightly acid (pH 6.3); clear wavy boundary.

Bt--3 to 14 inches; reddish brown (5YR 5/3) loam, dark reddish gray (5YR 4/2) moist, moderate thin platy structure parting to moderate fine subangular blocky; slightly hard, friable, sticky and plastic; common fine and medium roots; common fine tubular pores; common distinct clay films on faces of peds and lining pores; slightly acid (pH 6.7); clear wavy boundary.

Bw--14 to 26 inches; reddish brown (5YR 5/3) sandy loam, dark reddish gray (5YR 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, very sticky and plastic; common fine and medium roots; common fine tubular pores; continuous clay films on faces of peds and lining pores; slightly acid (pH 6.6); clear wavy boundary.

C1--26 to 34 inches; reddish brown (5YR 5/3) sandy loam; reddish brown (5YR 4/3) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and medium roots; few fine tubular pores; neutral (pH 7.0); gradual wavy boundary. (5 to 25 inches thick)

C2--34 to 42 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots to 40 inches; neutral (pH 6.9).

C2--42 to 60 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots to 40 inches; neutral (pH 7.1).

TYPE LOCATION: Sweetwater County, WY. Refer to waypoint 107 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
Depth to an accumulation of secondary calcium carbonates is 10 to 20 inches. The mean annual

soil temperature is 42 to 46 degrees F. Rock fragments in the particle size control section range from 0 to 15 percent gravel. The moisture control section is usually dry. It is usually moist in April, May, and early June, and dry for 60 consecutive days during the 90 day period following the summer solstice.

The A horizon has hue of 10YR through 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4 dry and moist. Reaction is neutral through moderately alkaline.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 6 dry and moist. It is typically a clay loam but may be loam or sandy clay loam with 18 to 35 percent clay and less than 35 percent fine sandy or coarser. Reaction is mildly through strongly alkaline. EC is less than 8 mmhos.

The Bk horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 3 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam, sandy clay loam, or clay loam. Some pedons have sandy loam textures in the lower Bk. EC is less than 8 mmhos. Calcium carbonate ranges from 4 to 12 percent.

The C horizon has hue of 7.5YR or 5YR, value of 4 through 7 dry, 4 through 6 moist, and chroma of 2 through 6 dry and moist. Texture is loam or fine sandy loam. Calcium carbonate ranges from 2 to 10 percent. EC is less than 8 mmhos throughout. Reaction is moderately through very strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 26 inches, with the following marginal parameter:

- Saturation percentage, 20 to 46 inches

GEOGRAPHIC SETTING (according to official soil series description): Almy soils are on nearly level to moderately sloping alluvial fan aprons and fan piedmonts. Parent materials are weathered from interbedded, red, fine sandstone and shale. Slopes are both simple and complex and range from 0 to 15 percent. Elevation ranges from 5,400 feet to 7,800 feet. The mean annual precipitation is about 12 inches but ranges from 9 to 14 inches with over half falling in April, May, and June. The mean annual air temperature ranges from 42 to 46 degrees F. The frost-free season ranges from 60 to 110 days.

VARIATION FROM TYPICAL SERIES: Less alkaline and somewhat less clay than typical.

BLUERIM SERIES

SOIL MAPPING UNIT: Br

SOIL SAMPLE LOCATION: 2

The Bluerim series consists of moderately deep, well drained soils that formed in material weathered from calcareous sandy shale interbedded with arkosic sandstone. Bluerim soils are on upland hillsides and have slopes of 3 to 20 percent. The mean annual precipitation is about 11 inches, and the mean annual temperature is about 39 degrees F.

TYPICAL PEDON: Bluerim sandy soil-rangeland. The surface is covered with 15 percent very fine pebbles. (Colors are for dry soil unless otherwise stated.)

A--0 to 1 inches; red brown (10YR 5/3) sandy loam, very dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; neutral (pH 6.9); clear smooth boundary.

Bt--1 to 12 inches; red brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; neutral (pH 6.9); clear smooth boundary.

C1--12 to 14 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium angular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; few medium roots; few thin clay films on faces of some peds; 10 percent very fine pebbles; neutral (pH 7.0); clear smooth boundary.

C2--14 to 22 inches; light olive brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent very fine pebbles; slightly calcareous, lime in a few masses and seams; neutral (pH 7.0); gradual wavy boundary.

Cr--22 to 60* inches; soft, olive, calcareous sandy shale with seams and nests of lime.

*Verified to 36 inches, varying colored layers of coarse olive and red calcareous weathered sandstone.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 2 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): The mean annual soil temperature ranges from 35 to 47 degrees F., and the mean summer soil temperature ranges from 59 to 62 degrees F. Depth to bedded sandy shale is 20 to 40 inches. The soils commonly are noncalcareous. Calcium carbonate accumulation in the lower part of the C horizon is weak and discontinuous. Very fine pebbles range from 0 to 15 percent throughout.

The A1 horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 2 through 4 dry and moist. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The Bt2 horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 4 or 5 moist, and chroma of 3 or 4 dry and moist. Texture is sandy clay loam with 20 to 27 percent clay. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The C horizon has hue of 5Y through 10YR, value of 4 through 7 dry, 5 or 6 moist, and chroma of 2 through 4. It is sandy loam or sandy clay loam. EC is less than 4 mmhos. Reaction ranges from mildly alkaline through strongly alkaline. Visible accumulation of calcium carbonate is discontinuous.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 12 inches, with the following marginal parameter:

- Saturation percentage, 12 to 22 inches

GEOGRAPHIC SETTING (according to official soil series description): Bluerim soils are on upland hillsides. Slopes are 3 to 20 percent. The soils formed in residuum weathered from calcareous sandy shales interbedded with arkosic sandstone. Elevation is 6,000 to 7,800 feet. The mean annual temperature is 34 to 45 degrees F. Precipitation is 10 to 14 inches. The growing season is 80 to 120 days but frost may occur in any month.

VARIATION FROM TYPICAL SERIES: Slightly less alkaline than typical. Fewer B horizons than typical.

BLUERIM SERIES

SOIL MAPPING UNIT: Br

SOIL SAMPLE LOCATION: 6

The Bluerim series consists of moderately deep, well drained soils that formed in material weathered from calcareous sandy shale interbedded with arkosic sandstone. Bluerim soils are on upland hillsides and have slopes of 3 to 20 percent. The mean annual precipitation is about 11 inches, and the mean annual temperature is about 39 degrees F.

TYPICAL PEDON: Bluerim sandy soil-rangeland. The surface is covered with 15 percent very fine pebbles. (Colors are for dry soil unless otherwise stated.)

A--0 to 2 inches; brown (10YR 5/3) sandy loam, very dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; mildly acid (pH 6.0); clear smooth boundary.

Bw--2 to 12 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; mildly acid (pH 6.0); clear smooth boundary.

C1--12 to 24 inches; yellow (2.5Y 8/3) sandy loam, yellow brown (2.5Y 7/3) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent very fine pebbles; slightly acid (pH 6.5); gradual wavy boundary.

C2--24 to 40 inches; light olive brown (2.5Y 5/4) loamy sand, olive brown (2.5Y 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent very fine pebbles; slightly calcareous, lime in a few masses and seams; slightly alkaline (pH 7.2); coarse, stratified horizon, yellow to 30 inches, pale olive to 36 inches, white to 40 inches.

Cr--40* to 60 inches; soft, olive, calcareous sandy shale with seams and nests of lime.

* Verified to 47 inches, with paralithic material encountered at 40 inches: very coarse yellow weathered sandstone.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 6 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): The mean annual soil temperature ranges from 35 to 47 degrees F., and the mean summer soil temperature ranges from 59 to 62 degrees F. Depth to bedded sandy shale is 20 to 40 inches. The soils commonly are noncalcareous. Calcium carbonate accumulation in the lower part of the C horizon is weak and discontinuous. Very fine pebbles range from 0 to 15 percent throughout.

The A1 horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 2 through 4 dry and moist. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The Bt2 horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 4 or 5 moist, and chroma of 3 or 4 dry and moist. Texture is sandy clay loam with 20 to 27 percent clay. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The C horizon has hue of 5Y through 10YR, value of 4 through 7 dry, 5 or 6 moist, and chroma of 2 through 4. It is sandy loam or sandy clay loam. EC is less than 4 mmhos. Reaction ranges from mildly alkaline through strongly alkaline. Visible accumulation of calcium carbonate is discontinuous.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 12 inches, with the following marginal parameter:

- Saturation percentage, 12 to 47 inches

GEOGRAPHIC SETTING (according to official soil series description): Bluerim soils are on upland hillsides. Slopes are 3 to 20 percent. The soils formed in residuum weathered from calcareous sandy shales interbedded with arkosic sandstone. Elevation is 6,000 to 7,800 feet. The mean annual temperature is 34 to 45 degrees F. Precipitation is 10 to 14 inches. The growing season is 80 to 120 days but frost may occur in any month.

VARIATION FROM TYPICAL SERIES: Fewer B horizons than typical. Less alkaline C horizons than typical.

BLUERIM SERIES

SOIL MAPPING UNIT: Br

SOIL SAMPLE LOCATION: 12

The Bluerim series consists of moderately deep, well drained soils that formed in material weathered from calcareous sandy shale interbedded with arkosic sandstone. Bluerim soils are on upland hillsides and have slopes of 3 to 20 percent. The mean annual precipitation is about 11 inches, and the mean annual temperature is about 39 degrees F.

TYPICAL PEDON: Bluerim sandy soil-rangeland. The surface is covered with 15 percent very fine pebbles. (Colors are for dry soil unless otherwise stated.)

A--0 to 1 inches; brown (10YR 5/3) sandy loam, very dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; slightly alkaline (pH 7.2); clear smooth boundary.

Bw--1 to 9 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; slightly alkaline (pH 7.2); clear smooth boundary.

BC--9 to 12 inches; light orange yellow (10YR 7/4) sandy loam, dark orange yellow (10YR 6/4) moist; moderate medium angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few medium roots; continuous thin clay films on faces of peds; 10 percent very fine pebbles; mildly alkaline (pH 7.5); abrupt smooth boundary.

C1--12 to 20 inches; light orange yellow (10YR 7/4) sandy loam, dark orange yellow (10YR 6/4) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent very fine pebbles; slightly calcareous; mildly alkaline (pH 7.5); gradual wavy boundary.

C2--20 to 26 inches; light olive brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent very fine pebbles; slightly calcareous; moderately alkaline (pH 7.8); gradual wavy boundary.

Cr—26* to 60 inches; soft, olive, calcareous sandy shale with seams and nests of lime.

* 26 to 36 inches verified as fine weathered, pale tan sandstone.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 12 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): The mean annual soil temperature ranges from 35 to 47 degrees F., and the mean summer soil temperature

ranges from 59 to 62 degrees F. Depth to bedded sandy shale is 20 to 40 inches. The soils commonly are noncalcareous. Calcium carbonate accumulation in the lower part of the C horizon is weak and discontinuous. Very fine pebbles range from 0 to 15 percent throughout.

The A1 horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 2 through 4 dry and moist. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The Bt2 horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 4 or 5 moist, and chroma of 3 or 4 dry and moist. Texture is sandy clay loam with 20 to 27 percent clay. EC is less than 2 mmhos. Reaction is neutral or mildly alkaline.

The C horizon has hue of 5Y through 10YR, value of 4 through 7 dry, 5 or 6 moist, and chroma of 2 through 4. It is sandy loam or sandy clay loam. EC is less than 4 mmhos. Reaction ranges from mildly alkaline through strongly alkaline. Visible accumulation of calcium carbonate is discontinuous.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 20 inches, with the following marginal parameter:

- Saturation percentage, 20 to 26 inches

GEOGRAPHIC SETTING (according to official soil series description): Bluerim soils are on upland hillsides. Slopes are 3 to 20 percent. The soils formed in residuum weathered from calcareous sandy shales interbedded with arkosic sandstone. Elevation is 6,000 to 7,800 feet. The mean annual temperature is 34 to 45 degrees F. Precipitation is 10 to 14 inches. The growing season is 80 to 120 days but frost may occur in any month.

VARIATION FROM TYPICAL SERIES: Less developed B horizons than typical.

BYRNIE SERIES

SOIL MAPPING UNIT: By

SOIL SAMPLE LOCATION: 13

The Byrnie series consists of very shallow and shallow, well drained soils that formed in slope alluvium over residuum derived from reddish colored sandstone. These soils are on gently sloping to very steep hills and ridges. Slopes are 2 to 60 percent. The mean annual precipitation is about 12 inches and the mean annual temperature is about 43 degrees F.

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

A--0 to 2 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; moderate fine granular structure; soft, very friable, nonplastic, nonsticky; common very fine and fine roots; common fine and very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

Bw--2 to 5 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; neutral (pH 7.0); clear smooth boundary.

Bt--5 to 13 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; mildly alkaline (pH 7.5); clear smooth boundary.

C--13 to 17 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonplastic, nonsticky; slightly alkaline (pH 7.2); clear wavy boundary. (2 to 19 inches thick.)

Cr--17 inches; soft calcareous reddish brown sandstone, with calcareous fragments.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 13 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Mean annual soil temperature: 40 to 45 degrees F.
Depth to the paralithic contact: 4 to 20 inches to weathered sandstone
The profile is usually calcareous throughout but may be leached in some pedons in the A horizon.

A horizon:
Hue: 2.5YR through 7.5YR

Value: 5 through 7 dry, 4 through 6 moist
Chroma: 3 through 6 dry or moist
Texture: sandy loam, fine sandy loam or very fine sandy loam
Rock fragments: 0 to 35 percent gravel and cobble
Reaction: slightly alkaline to strongly alkaline

C horizon:
Hue: 2.5YR to 7.5YR
Value: 4 through 6 dry, 4 or 5 moist
Chroma: 4 through 6 dry or moist
Texture: sandy loam or fine sandy loam
Rock fragments: 0 to 35 percent gravel or cobble
Allogenic calcium carbonate equivalent: 5 to 20 percent
Reaction: slightly alkaline through strongly alkaline
Some pedons have a weak Bk horizon.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 13 inches, with no marginal or unsuitable values in the profile.

GEOGRAPHIC SETTING (according to official soil series description): Parent material: slope alluvium over residuum derived from reddish colored sandstone
Landform: gently sloping to very steep hills and ridges
Slopes: 2 to 60 percent
Elevation: 6000 to 7800 feet
Mean annual precipitation: at the type location it is about 12 inches but ranges 10 to 15 inches with peak periods of precipitation occurring in the spring and early summer months
Mean annual air temperature: 40 to 45 degrees F.
Frost-free period: 85 to 100 days

VARIATION FROM TYPICAL SERIES: Bt and Bw horizons not typical of series.

BYRNIE SERIES

SOIL MAPPING UNIT: By

SOIL SAMPLE LOCATION: 15

The Byrnie series consists of very shallow and shallow, well drained soils that formed in slope alluvium over residuum derived from reddish colored sandstone. These soils are on gently sloping to very steep hills and ridges. Slopes are 2 to 60 percent. The mean annual precipitation is about 12 inches and the mean annual temperature is about 43 degrees F.

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

A--0 to 2 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; moderate fine granular structure; soft, very friable, nonplastic, nonsticky; common very fine and fine roots; common fine and very fine tubular pores; mildly acid (pH 6.6); clear smooth boundary.

Bt--2 to 12 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; mildly acid (pH 6.6); clear smooth boundary.

C--12 to 16 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonplastic, nonsticky; slightly alkaline (pH 7.2); clear wavy boundary.

Cr--16 inches; soft calcareous reddish brown sandstone containing crystalline fragments.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 15 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Mean annual soil temperature: 40 to 45 degrees F.
Depth to the paralithic contact: 4 to 20 inches to weathered sandstone
The profile is usually calcareous throughout but may be leached in some pedons in the A horizon.

A horizon:
Hue: 2.5YR through 7.5YR
Value: 5 through 7 dry, 4 through 6 moist
Chroma: 3 through 6 dry or moist
Texture: sandy loam, fine sandy loam or very fine sandy loam
Rock fragments: 0 to 35 percent gravel and cobble
Reaction: slightly alkaline to strongly alkaline

C horizon:
Hue: 2.5YR to 7.5YR
Value: 4 through 6 dry, 4 or 5 moist
Chroma: 4 through 6 dry or moist
Texture: sandy loam or fine sandy loam
Rock fragments: 0 to 35 percent gravel or cobble
Allogenic calcium carbonate equivalent: 5 to 20 percent
Reaction: slightly alkaline through strongly alkaline
Some pedons have a weak Bk horizon.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 12 inches, with no marginal or unsuitable values in the profile.

GEOGRAPHIC SETTING (according to official soil series description): Parent material: slope alluvium over residuum derived from reddish colored sandstone
Landform: gently sloping to very steep hills and ridges
Slopes: 2 to 60 percent
Elevation: 6000 to 7800 feet
Mean annual precipitation: at the type location it is about 12 inches but ranges 10 to 15 inches with peak periods of precipitation occurring in the spring and early summer months
Mean annual air temperature: 40 to 45 degrees F.
Frost-free period: 85 to 100 days

VARIATION FROM TYPICAL SERIES: Somewhat less alkaline than typical. Bt horizon not typical of series.

BYRNIE SERIES

SOIL MAPPING UNIT: Br

SOIL SAMPLE LOCATION: 18

The Byrnie series consists of very shallow and shallow, well drained soils that formed in slope alluvium over residuum derived from reddish colored sandstone. These soils are on gently sloping to very steep hills and ridges. Slopes are 2 to 60 percent. The mean annual precipitation is about 12 inches and the mean annual temperature is about 43 degrees F.

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

A--0 to 3 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; moderate fine granular structure; soft, very friable, nonplastic, nonsticky; common very fine and fine roots; common fine and very fine tubular pores; slightly alkaline (pH 7.2); clear smooth boundary. (1 to 4 inches thick.)

Bw--3 to 10 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; 10 percent very fine pebbles; slightly alkaline (pH 7.2); clear smooth boundary.

C1--10 to 15 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonplastic, nonsticky; slightly alkaline (pH 7.3); clear wavy boundary.

C2--15 to 18 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonplastic, nonsticky; slightly alkaline (pH 7.3); clear wavy boundary.

Cr--18 inches; soft calcareous pale yellow to gray sandstone with coarse fragments.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 18 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Mean annual soil temperature: 40 to 45 degrees F.
Depth to the paralithic contact: 4 to 20 inches to weathered sandstone
The profile is usually calcareous throughout but may be leached in some pedons in the A horizon.

A horizon:
Hue: 2.5YR through 7.5YR
Value: 5 through 7 dry, 4 through 6 moist

Chroma: 3 through 6 dry or moist
Texture: sandy loam, fine sandy loam or very fine sandy loam
Rock fragments: 0 to 35 percent gravel and cobble
Reaction: slightly alkaline to strongly alkaline

C horizon:
Hue: 2.5YR to 7.5YR
Value: 4 through 6 dry, 4 or 5 moist
Chroma: 4 through 6 dry or moist
Texture: sandy loam or fine sandy loam
Rock fragments: 0 to 35 percent gravel or cobble
Allogenic calcium carbonate equivalent: 5 to 20 percent
Reaction: slightly alkaline through strongly alkaline
Some pedons have a weak Bk horizon.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 10 inches, with no marginal or unsuitable values in the profile.

GEOGRAPHIC SETTING (according to official soil series description): Parent material: slope alluvium over residuum derived from reddish colored sandstone
Landform: gently sloping to very steep hills and ridges
Slopes: 2 to 60 percent
Elevation: 6000 to 7800 feet
Mean annual precipitation: at the type location it is about 12 inches but ranges 10 to 15 inches with peak periods of precipitation occurring in the spring and early summer months
Mean annual air temperature: 40 to 45 degrees F.
Frost-free period: 85 to 100 days

VARIATION FROM TYPICAL SERIES: Bw horizon not typical of series.

CARMODY SERIES

SOIL MAPPING UNIT: Cm

SOIL SAMPLE LOCATION: 101

The Carmody series consists of well to somewhat excessively drained soils that are moderately deep to siltstone. These soils formed in material weathered from calcareous siltstone or fine grained sandstone. Carmody soils are on uplands of the cold intermountain basins. Slopes are 2 to 45 percent. The mean annual precipitation is about 14 inches, and the mean annual temperature is about 44 degrees F.

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

A--0 to 3 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; mildly acid (pH 6.6); gradual wavy boundary.

AC/C1--3 to 10 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; slightly alkaline (pH 7.2); abrupt wavy boundary. (16 to 30 inches thick)

C2--10 to 24 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; strongly effervescent, lime disseminated; mildly alkaline (pH 7.6); abrupt wavy boundary. (16 to 30 inches thick)

Cr—24* to 60 inches; light brownish gray to white, calcareous siltstone containing fine grained sand.

* Verified to paralithic material from 24 to 48 inches.

TYPE LOCATION: Sweetwater, WY. Refer to Waypoint 101 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Depth to a paralithic contact is 20 to 40 inches. Depth to uniformly calcareous material is 0 to 10 inches. The mean annual soil temperature ranges from about 40 to 47 degrees F., and the mean summer soil temperature ranges from about 59 to 63 degrees F. The control section is very fine sandy loam or fine sandy loam, averaging 10 to 18 percent clay and more than 15 percent fine sand or coarser. Flat fragments or fine pebbles range from 0 to 15 percent. Thin, discontinuous horizons of carbonate accumulation occur immediately above the paralithic contact in some pedons.

The A horizon has hue of 2.5Y or 10YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. EC is less than 2 mmhos. Reaction is mildly or moderately alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 4 through 7 dry, 3 through 5 moist, and chroma of 2 through 6. EC is less than 2 mmhos. Reaction is moderately or strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 3 inches, with no marginal or unsuitable values in the profile. Calcium carbonate was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description): Carmody soils are on plateaus and hillslopes in intermountain basins. Slopes are 2 to 45 percent. The soils formed in calcareous material weathered from semi-consolidated fine grained sandstone or siltstone. The mean annual precipitation ranges from 10 to 17 inches of which about half falls as snow or rain in April, May, and early June. Elevation is 5,300 to 7,500 feet. The mean annual temperature is 39 to 45 degrees F., and the mean summer temperature is 58 to 65 degrees F. The frost-free season is 75 to 120 days depending upon aspect, elevation, and local air drainage.

VARIATION FROM TYPICAL SERIES: Less alkaline than typical in top of profile.

CARMODY SERIES

SOIL MAPPING UNIT: Cm

SOIL SAMPLE LOCATION: 105

The Carmody series consists of well to somewhat excessively drained soils that are moderately deep to siltstone. These soils formed in material weathered from calcareous siltstone or fine grained sandstone. Carmody soils are on uplands of the cold intermountain basins. Slopes are 2 to 45 percent. The mean annual precipitation is about 14 inches, and the mean annual temperature is about 44 degrees F.

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

A--0 to 1 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; neutral (pH 6.8); gradual wavy boundary.

AC--1 to 12 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; neutral (pH 6.8); abrupt wavy boundary.

C1--12 to 30 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; slightly alkaline (pH 7.3); abrupt wavy boundary.

C2 --30 to 35 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; violently effervescent, lime disseminated; moderately alkaline (pH 7.6); abrupt wavy boundary.

Cr—35* to 60 inches; light brownish gray to white, calcareous siltstone containing fine grained sand.

*Verified 35 to 36 inches, pink sandstone.

TYPE LOCATION: Sweetwater, WY. Refer to Waypoint 105 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Depth to a paralithic contact is 20 to 40 inches. Depth to uniformly calcareous material is 0 to 10 inches. The mean annual soil temperature ranges from about 40 to 47 degrees F., and the mean summer soil temperature ranges from about 59 to 63 degrees F. The control section is very fine sandy

loam or fine sandy loam, averaging 10 to 18 percent clay and more than 15 percent fine sand or coarser. Flat fragments or fine pebbles range from 0 to 15 percent. Thin, discontinuous horizons of carbonate accumulation occur immediately above the paralithic contact in some pedons.

The A horizon has hue of 2.5Y or 10YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. EC is less than 2 mmhos. Reaction is mildly or moderately alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 4 through 7 dry, 3 through 5 moist, and chroma of 2 through 6. EC is less than 2 mmhos. Reaction is moderately or strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 12 inches, with the following marginal parameters:

- Saturation percentage, 12 to 35 inches.

Additionally, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description): Carmody soils are on plateaus and hillslopes in intermountain basins. Slopes are 2 to 45 percent. The soils formed in calcareous material weathered from semi-consolidated fine grained sandstone or siltstone. The mean annual precipitation ranges from 10 to 17 inches of which about half falls as snow or rain in April, May, and early June. Elevation is 5,300 to 7,500 feet. The mean annual temperature is 39 to 45 degrees F., and the mean summer temperature is 58 to 65 degrees F. The frost-free season is 75 to 120 days depending upon aspect, elevation, and local air drainage.

VARIATION FROM TYPICAL SERIES: Less alkaline than typical in top of profile.

CARMODY SERIES

SOIL MAPPING UNIT: Cm

SOIL SAMPLE LOCATION: 111

The Carmody series consists of well to somewhat excessively drained soils that are moderately deep to siltstone. These soils formed in material weathered from calcareous siltstone or fine grained sandstone. Carmody soils are on uplands of the cold intermountain basins. Slopes are 2 to 45 percent. The mean annual precipitation is about 14 inches, and the mean annual temperature is about 44 degrees F.

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

A--0 to 4 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; slightly acid (pH 6.7); gradual wavy boundary.

AC--4 to 12 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; slightly acid (pH 6.6); abrupt wavy boundary.

C--12 to 24 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure; slightly hard, friable, slightly sticky; few fine and many medium roots; moderately effervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

Cr—24* to 60 inches; light brownish gray to white, calcareous siltstone containing fine grained sand.

*Verified 24 to 36 inches, olive sandstone.

TYPE LOCATION: Sweetwater, WY. Refer to Waypoint 111 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description): Depth to a paralithic contact is 20 to 40 inches. Depth to uniformly calcareous material is 0 to 10 inches. The mean annual soil temperature ranges from about 40 to 47 degrees F., and the mean summer soil temperature ranges from about 59 to 63 degrees F. The control section is very fine sandy loam or fine sandy loam, averaging 10 to 18 percent clay and more than 15 percent fine sand or coarser. Flat fragments or fine pebbles range from 0 to 15 percent. Thin, discontinuous horizons of carbonate accumulation occur immediately above the paralithic contact in some pedons.

The A horizon has hue of 2.5Y or 10YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. EC is less than 2 mmhos. Reaction is mildly or moderately alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 4 through 7 dry, 3 through 5 moist, and chroma of 2 through 6. EC is less than 2 mmhos. Reaction is moderately or strongly alkaline.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is marginal to a depth of 12 inches, with the following marginal parameters:

- Saturation percentage, 0 to 12 inches

Additionally, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description): Carmody soils are on plateaus and hillslopes in intermountain basins. Slopes are 2 to 45 percent. The soils formed in calcareous material weathered from semi-consolidated fine grained sandstone or siltstone. The mean annual precipitation ranges from 10 to 17 inches of which about half falls as snow or rain in April, May, and early June. Elevation is 5,300 to 7,500 feet. The mean annual temperature is 39 to 45 degrees F., and the mean summer temperature is 58 to 65 degrees F. The frost-free season is 75 to 120 days depending upon aspect, elevation, and local air drainage.

VARIATION FROM TYPICAL SERIES: Less alkaline than typical in top of profile.

CLOWERS SERIES

SOIL MAPPING UNIT: Cl

SOIL SAMPLE LOCATION: 10

The Clowers series consists of deep, well and moderately well drained soils formed in mixed, calcareous alluvium. Clowers soils are on alluvial flood plains and terraces. Slopes are typically 0 to 3 percent but range up to 6 percent. The mean annual precipitation is about 8 inches, and the mean annual temperature is about 40 degrees F.

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

A--0 to 5 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common medium and fine roots; 2 percent semi-rounded pebbles; mildly acid (pH 6.4); clear smooth boundary.

Bt1--5 to 12 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; neutral (pH 6.8); clear smooth boundary.

Bt2--12 to 28 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; neutral (pH 6.9); clear smooth boundary.

Btk--28 to 32 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; strongly effervescent, lime disseminated; mildly alkaline (pH 7.4); clear smooth boundary.

Ck1--32 to 36 inches; light brownish gray (2.5Y 6/2) sandy clay loam stratified with thin lenses of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and few medium roots; violently effervescent, lime disseminated; mildly alkaline (pH 7.4); gradual wavy boundary.

C2--36 to 42 inches; light brownish gray (2.5Y 6/2) sandy loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; violently effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.5).

C3--42 to 56 inches; light brownish gray (2.5Y 6/2) sandy clay loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.6).

C4--56 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.6).

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 10 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
These soils are typically calcareous at the surface but are leached up to 8 inches in some pedons. Depth to bedrock exceeds 60 inches. The mean annual soil temperature is about 41 to 47 degrees F., and the mean summer soil temperature is about 59 to 63 degrees F. The soil is stratified with individual strata whose textures range from sandy loam to clay loam. The particle size control, though stratified, averages 18 to 35 percent clay, 20 to 55 percent silt, and 20 to 55 percent sand with more than 15 but less than 35 percent fine or coarser sand. Bulk texture is loam or clay loam. Coarse fragments are variable within various strata but when averaged range from 0 to 15 percent pebbles within the control section. Calcium carbonate equivalent ranges from 2 to 10 percent throughout with only minor segregation. Gypsum crystals are common in some strata. ESP ranges from 0 to 15 percent with the highest concentration located in thin strata at depths of 20 to 40 inches or more.

The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 3 through 5 moist, and chroma of 1 through 4. EC ranges from 0 to 14 mmhos. Reaction is moderately or strongly alkaline.

The C horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Strata of sandy loam, sandy clay loam, loam, silt loam, silty clay loam, and clay loam are common and range from thin lenses to strata 10 inches thick. EC ranges from 0 to 14 mmhos in the upper part and from 0 to 8 in the lower part. Reaction is moderately or strongly alkaline.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, frigid Typic Torrifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 28 inches, with no marginal or unsuitable values in the profile. However, calcium carbonate was observed to be a limiting factor in the field.

GEOGRAPHIC SETTING (according to official soil series description):
Clowers soils are on nearly level or gently sloping alluvial flood plains, drainageways, and terraces. These soils formed in stratified, calcareous alluvium from mixed sources. Elevation ranges from 6,300 to 7,400 feet. The mean annual precipitation is about 8 inches and ranges from 5 to 9 inches. About half falls as rain or snow in April, May, and early June. The mean annual temperature is about 40 degrees F. and ranges from 38 to 44 degrees F. The frost-free season is estimated to range from 60 to 90 days depending upon elevation, aspect, and air drainage.

VARIATION FROM TYPICAL SERIES: Somewhat less alkaline in top 34 inches of profile. Bt and Btk horizons not typical.

CLOWERS SERIES

SOIL MAPPING UNIT: Cl

SOIL SAMPLE LOCATION: 102

The Clowers series consists of deep, well and moderately well drained soils formed in mixed, calcareous alluvium. Clowers soils are on alluvial flood plains and terraces. Slopes are typically 0 to 3 percent but range up to 6 percent. The mean annual precipitation is about 8 inches, and the mean annual temperature is about 40 degrees F.

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

A--0 to 14 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common medium and fine roots; slightly effervescent, lime disseminated; 2 percent semirounded pebbles; mildly acid (pH 6.3); clear smooth boundary.

C1--14 to 24 inches; light brownish gray (2.5Y 6/2) sandy loam stratified with thin lenses of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and few medium roots to 22 inches; lime disseminated; neutral (pH 6.9); gradual wavy boundary.

C2--24 to 34 inches; light brownish gray (2.5Y 6/2) loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; lime disseminated; neutral (pH 7.0).

C3--34 to 46 inches; light brownish gray (2.5Y 6/2) sandy clay loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots to 30 inches; lime disseminated; moderately alkaline (pH 7.5).

C4--46 to 57 inches; light brownish gray (2.5Y 6/2) loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots to 30 inches; moderately effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.7).

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 102 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
These soils are typically calcareous at the surface but are leached up to 8 inches in some pedons. Depth to bedrock exceeds 60 inches. The mean annual soil temperature is about 41 to 47 degrees

F., and the mean summer soil temperature is about 59 to 63 degrees F. The soil is stratified with individual strata whose textures range from sandy loam to clay loam. The particle size control, though stratified, averages 18 to 35 percent clay, 20 to 55 percent silt, and 20 to 55 percent sand with more than 15 but less than 35 percent fine or coarser sand. Bulk texture is loam or clay loam. Coarse fragments are variable within various strata but when averaged range from 0 to 15 percent pebbles within the control section. Calcium carbonate equivalent ranges from 2 to 10 percent throughout with only minor segregation. Gypsum crystals are common in some strata. ESP ranges from 0 to 15 percent with the highest concentration located in thin strata at depths of 20 to 40 inches or more.

The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 3 through 5 moist, and chroma of 1 through 4. EC ranges from 0 to 14 mmhos. Reaction is moderately or strongly alkaline.

The C horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Strata of sandy loam, sandy clay loam, loam, silt loam, silty clay loam, and clay loam are common and range from thin lenses to strata 10 inches thick. EC ranges from 0 to 14 mmhos in the upper part and from 0 to 8 in the lower part. Reaction is moderately or strongly alkaline.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, frigid Typic Torrifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 14 inches and marginal from 14 to 24 inches, with the following marginal parameter:

- Saturation percentage, 14 to 24 inches.

Additionally, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description):
Clowers soils are on nearly level or gently sloping alluvial flood plains, drainageways, and terraces. These soils formed in stratified, calcareous alluvium from mixed sources. Elevation ranges from 6,300 to 7,400 feet. The mean annual precipitation is about 8 inches and ranges from 5 to 9 inches with about half falling as rain or snow in April, May, and early June. The mean annual temperature is about 40 degrees F. and ranges from 38 to 44 degrees F. The frost-free season is estimated to range from 60 to 90 days depending upon elevation, aspect, and air drainage.

VARIATION FROM TYPICAL SERIES: Somewhat less alkaline in top 24 inches of profile.

CLOWERS SERIES

SOIL MAPPING UNIT: Cl

SOIL SAMPLE LOCATION: 113

The Clowers series consists of deep, well and moderately well drained soils formed in mixed, calcareous alluvium. Clowers soils are on alluvial flood plains and terraces. Slopes are typically 0 to 3 percent but range up to 6 percent. The mean annual precipitation is about 8 inches, and the mean annual temperature is about 40 degrees F.

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

A--0 to 1 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common medium and fine roots; 2 percent semirounded pebbles; neutral (pH 7.0); clear smooth boundary.

Bw--1 to 12 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; many fine and medium roots; continuous thin clay films on faces of all peds; neutral (pH 7.0); clear smooth boundary.

C1--12 to 20 inches; light brownish gray (2.5Y 6/2) sandy loam stratified with thin lenses of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and few medium roots; 2 percent rounded pebbles; mildly alkaline (pH 7.4); gradual wavy boundary.

C2--20 to 26 inches; light brownish gray (2.5Y 6/2) sandy loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; violently effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.5).

C2--26 to 46 inches; light brownish gray (2.5Y 6/2) sandy loam stratified with lenses of very fine sandy loam, clay loam, and silt loam, dark grayish brown (2.5Y 4/2) moist; massive with much of the original stratified layers in place; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots to 30 inches; strongly effervescent, lime disseminated and as few fine soft masses in various strata; 5 percent rounded pebbles; moderately alkaline (pH 7.8).

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 113 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
These soils are typically calcareous at the surface but are leached up to 8 inches in some pedons.

Depth to bedrock exceeds 60 inches. The mean annual soil temperature is about 41 to 47 degrees F., and the mean summer soil temperature is about 59 to 63 degrees F. The soil is stratified with individual strata whose textures range from sandy loam to clay loam. The particle size control, though stratified, averages 18 to 35 percent clay, 20 to 55 percent silt, and 20 to 55 percent sand with more than 15 but less than 35 percent fine or coarser sand. Bulk texture is loam or clay loam. Coarse fragments are variable within various strata but when averaged range from 0 to 15 percent pebbles within the control section. Calcium carbonate equivalent ranges from 2 to 10 percent throughout with only minor segregation. Gypsum crystals are common in some strata. ESP ranges from 0 to 15 percent with the highest concentration located in thin strata at depths of 20 to 40 inches or more.

The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 3 through 5 moist, and chroma of 1 through 4. EC ranges from 0 to 14 mmhos. Reaction is moderately or strongly alkaline.

The C horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Strata of sandy loam, sandy clay loam, loam, silt loam, silty clay loam, and clay loam are common and range from thin lenses to strata 10 inches thick. EC ranges from 0 to 14 mmhos in the upper part and from 0 to 8 in the lower part. Reaction is moderately or strongly alkaline.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, frigid Typic Torrifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 12 inches, with the following marginal parameter:

- Saturation percentage, 12 to 20 inches.

Additionally, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description):
Clowers soils are on nearly level or gently sloping alluvial flood plains, drainageways, and terraces. These soils formed in stratified, calcareous alluvium from mixed sources. Elevation ranges from 6,300 to 7,400 feet. The mean annual precipitation is about 8 inches and ranges from 5 to 9 inches with about half falling as rain or snow in April, May, and early June. The mean annual temperature is about 40 degrees F. and ranges from 38 to 44 degrees F. The frost-free season is estimated to range from 60 to 90 days depending upon elevation, aspect, and air drainage.

VARIATION FROM TYPICAL SERIES: Slightly less alkaline in top 12 inches of profile. Bw horizon atypical.

GOSLIN SERIES

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 106

The Goslin series consists of deep, well drained soils that formed in coarse textured alluvium derived from red sandstone. The Goslin soils are on fan aprons, fan pediments, and alluvial terraces. Slopes are 3 to 25 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 43 degrees F.

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

A--0 to 6 inches; yellowish brown (10YR 5/4) fine loamy sand, dark brown (7.5YR 4/4) moist; weak coarse platy structure; soft, very friable, slightly sticky and nonplastic; many fine, medium, and coarse roots; moderately alkaline (pH 7.4); abrupt wavy boundary.

C1--6 to 14 inches; light brown (7.5YR 5/4) fine loamy sand, dark brown (7.5YR 4/4) moist; very weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine, medium, and coarse roots to 14 inches; moderately alkaline (pH 7.5); gradual wavy boundary.

C2--14 to 34 inches; white (5YR 7/2) fine loamy sand, pale brown (5YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; strongly alkaline (pH 7.8).

C2--34 to 46 inches; white (5YR 7/2) fine loamy sand, pale brown (5YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; strongly alkaline (pH 7.9).

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 106 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
The mean annual soil temperature is 44 to 46 degrees F., and the mean summer soil temperature is 59 to 63 degrees F. The particle-size control section is sandy loam or fine sandy loam modified with 0 to 35 percent coarse fragments. Clay ranges from 8 to 18 percent. It is moderately alkaline or strongly alkaline throughout. EC ranges from 0 to 4 mmhos.

The A horizon has hue of 10YR through 2.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. A surface covering of gravel lag is common in some pedons.

The C horizon has hue of 7.5YR through 2.5YR, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4. Carbonates range from 5 to 20 percent with less than one-fourth as pedogenetic accumulation.

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

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 0 inches, with the following marginal parameter:

- Saturation percentage, 0 to 46 inches.

Additionally, calcium carbonate content was observed in the field to be a limiting factor, as was sand content.

GEOGRAPHIC SETTING (according to official soil series description):
Goslin soils are on fan aprons, fan pediments, and alluvial terraces. They formed in coarse textured alluvium derived from red sandstone. Slopes are 3 to 25 percent. Elevations range from 6,300 to 7,500 feet. The mean annual precipitation is 9 to 14 inches with about half falling as snow or rain in April, May, and early June. The mean annual temperature is about 42 to 46 degrees F. The frost-free period is 60 to 90 days.

VARIATION FROM TYPICAL SERIES: Somewhat less alkaline than typical.

TEAGULF SERIES

SOIL MAPPING UNIT: Tg

SOIL SAMPLE LOCATION: 1

The Teagulf series consists of moderately deep, well drained soils that formed in modified residuum and slopewash alluvium from calcareous sedimentary rocks. Teagulf soils are on erosional upland plains and alluvial fans. Slopes are 0 to 8 percent. The mean annual precipitation is about 8 inches. The mean annual temperature is about 43 degrees F.

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

A--0 to 2 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 7.1); clear wavy boundary.

Bt--2 to 17 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, friable; slightly sticky, nonplastic; common fine roots; moderately alkaline (pH 7.6); clear wavy boundary.

C1k--17 to 28 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; violently effervescent, lime is segregated in soft masses; moderately alkaline (pH 7.6).

C2--28 to 36 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; moderately effervescent, lime is segregated in soft masses; moderately alkaline (pH 7.6).

Cr--36 inches; soft sandstone.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 1 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
The mean annual soil temperature is 43 degrees to 47 degrees F. The mean summer soil temperature is 63 degrees to 68 degrees F. Coarse fragment content is typically less than 5 percent but ranges in some pedons from 0 to 15 percent and consists of gravel and channers. Depth to horizons of continuous carbonate accumulation is 7 to 20 inches. Depth to bedrock is typically 28 to 35 inches but may range from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y; values of 5 through 7 dry, 4 or 5 moist; and chroma of 2 through 4 dry and moist. Textures are fine sandy loam, sandy loam, or loamy fine sand. Reaction is mildly or moderately alkaline. Effervescence ranges from none to strong. Salinity is 0 to 2 mmhos/cm.

The B horizon has hue of 10YR or 2.5Y; values of 5 through 7 dry, 4 or 5 moist; and chroma of 2 through 6 dry and moist. Textures are fine sandy loam or sandy loam. Reaction is mildly or moderately alkaline. Structure is weak prismatic or weak subangular blocky. Effervescence is slight to strong. Salinity is 0 to 2 mmhos/cm.

The Ck horizon has hues of 10YR or 2.5Y; values of 6 or 8 dry, 4 to 6 moist; and chroma of 2 through 6 dry and moist. Textures are fine sandy loam or sandy loam. Reaction is moderately or strongly alkaline. Effervescence is strong or violent. Salinity is 0 to 4 mmhos/cm. Carbonate equivalent ranges from 8 to 25 percent.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, frigid Typic Haplocalcids

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 17 inches, with no marginal or unsuitable parameters within the profile. However, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description):
Teagulf soils are on nearly level and gently sloping erosional upland plains and alluvial fans. The soils formed in modified residuum and slopewash alluvium from sedimentary rocks. Slopes are 0 to 8 percent. Elevations range from 6,000 to 7,300 feet. Average annual precipitation is 6 to 9 inches. The mean annual air temperature is 38 degrees to 45 degrees F., and the mean summer air temperature is 61 degrees to 66 degrees F. The frost-free season is about 80 to 110 days..

VARIATION FROM TYPICAL SERIES: A horizon somewhat less alkaline than typical. Lower calcium carbonate content than typical in Ck horizon.

TEAGULF SERIES

SOIL MAPPING UNIT: Br

SOIL SAMPLE LOCATION: 17

The Teagulf series consists of moderately deep, well drained soils that formed in modified residuum and slopewash alluvium from calcareous sedimentary rocks. Teagulf soils are on erosional upland plains and alluvial fans. Slopes are 0 to 8 percent. The mean annual precipitation is about 8 inches. The mean annual temperature is about 43 degrees F.

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

A1--0 to 1 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.8); clear wavy boundary.

Bw--1 to 6 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, friable; slightly sticky, nonplastic; common fine roots; slightly effervescent, lime segregated in lower part; neutral (pH 6.8); clear wavy boundary.

C1--6 to 16 inches; pale yellow brown (2.5Y 7/4) fine sandy loam, yellow brown (2.5Y 6/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; mildly alkaline (pH 7.3).

C2k--16 to 20 inches; pale yellow white (2.5Y 8/2) fine sandy loam, pale yellow brown (2.5Y 6/2) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; violently effervescent, lime is segregated in soft masses; moderately alkaline (pH 7.5).

Cr—20 to 36 inches; soft sandstone.

TYPE LOCATION: Sweetwater County, WY. Refer to Waypoint 17 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official soil series description):
The mean annual soil temperature is 43 degrees to 47 degrees F. The mean summer soil temperature is 63 degrees to 68 degrees F. Coarse fragment content is typically less than 5 percent but ranges in some pedons from 0 to 15 percent and consists of gravel and channers. Depth to horizons of continuous carbonate accumulation is 7 to 20 inches. Depth to bedrock is typically 28 to 35 inches but may range from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y; values of 5 through 7 dry, 4 or 5 moist; and chroma of 2 through 4 dry and moist. Textures are fine sandy loam, sandy loam, or loamy fine sand.

Reaction is mildly or moderately alkaline. Effervescence ranges from none to strong. Salinity is 0 to 2 mmhos/cm.

The B horizon has hue of 10YR or 2.5Y; values of 5 through 7 dry, 4 or 5 moist; and chroma of 2 through 6 dry and moist. Textures are fine sandy loam or sandy loam. Reaction is mildly or moderately alkaline. Structure is weak prismatic or weak subangular blocky. Effervescence is slight to strong. Salinity is 0 to 2 mmhos/cm.

The Ck horizon has hues of 10YR or 2.5Y; values of 6 or 8 dry, 4 to 6 moist; and chroma of 2 through 6 dry and moist. Textures are fine sandy loam or sandy loam. Reaction is moderately or strongly alkaline. Effervescence is strong or violent. Salinity is 0 to 4 mmhos/cm. Carbonate equivalent ranges from 8 to 25 percent.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, frigid Typic Haplocalcids

SUITABILITY FOR TOPSOIL (according to WDEQ-LQD Guideline 1, 1994): This soil is suitable to a depth of 16 inches, with no marginal or unsuitable parameters. However, calcium carbonate content was observed in the field to be a limiting factor.

GEOGRAPHIC SETTING (according to official soil series description):
Teagulf soils are on nearly level and gently sloping erosional upland plains and alluvial fans. The soils formed in modified residuum and slopewash alluvium from sedimentary rocks. Slopes are 0 to 8 percent. Elevations range from 6,000 to 7,300 feet. Average annual precipitation is 6 to 9 inches. The mean annual air temperature is 38 degrees to 45 degrees F., and the mean summer air temperature is 61 degrees to 66 degrees F. The frost-free season is about 80 to 110 days.

VARIATION FROM TYPICAL SERIES: Somewhat less alkaline than typical. Lower calcium carbonate content than typical in Ck horizon.

ADDENDUM D7-1-D
SOIL LABORATORY ANALYSIS

LABORATORY ANALYTICAL REPORT
Prepared by Gillette, WY Branch

Client: Lidstone and Associates
Project: Lost Creek East Uranium
Workorder: G12110266

Report Date: 12/18/12
Date Received: 11/12/12

	Analysis	SAT	OM-WB	Coarse Fragments	Sand	Silt	Clay	Texture	pH-SatPst	COND	Ca-SatPst	Mg-SatPst	Na-SatPst	SAR-sat paste
	Units	wt%	%	%	%	%	%	%	s_u_	mmhos/cm	meq/L	meq/L	meq/L	unitless
Sample ID	Client Sample ID	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
G12110266-001	1, 0-17 in.	27	0.5	< 2	64	20	16	SL	7.1	1.0	6.04	2.47	0.73	0.4
G12110266-002	1, 17-28 in.	32	0.4	< 2	66	18	16	SL	7.6	0.8	4.22	1.94	2.21	1.3
G12110266-003	1, 28-36 in.	26	0.2	< 2	74	18	8	SL	7.6	1.5	5.73	2.98	5.67	2.7
G12110266-004	2, 0-12 in.	27	0.7	9	62	24	14	SL	6.9	1.0	6.33	2.59	0.48	0.2
G12110266-005	2, 12-22 in.	18	< 0.2	6	78	6	16	SL	7.0	1.4	8.02	3.33	0.56	0.2
G12110266-006	6, 0-12 in.	27	0.8	5	58	28	14	SL	8.0	0.3	1.46	0.59	0.19	0.2
G12110266-007	6, 12-24 in.	23	0.3	6	76	16	8	SL	8.5	0.2	1.17	0.47	0.31	0.3
G12110266-008	6, 24-47 in.	21	< 0.2	12	82	12	6	LS	7.2	0.5	2.60	0.85	1.02	0.8
G12110266-009	10, 0-5 in.	31	1.5	4	44	38	18	L	8.4	0.4	2.10	0.91	0.27	0.2
G12110266-010	10, 5-12 in.	33	0.9	2	42	38	20	L	8.8	0.3	1.86	0.76	0.36	0.3
G12110266-011	10, 12-28 in.	40	0.6	5	32	44	24	L	8.9	0.4	2.62	1.01	0.58	0.4
G12110266-012	10, 28-36 in.	33	0.7	8	52	26	22	SCL	7.4	0.8	4.59	1.42	0.63	0.4
G12110266-013	10, 36-42 in.	29	0.3	12	66	18	16	SL	7.5	0.5	3.27	0.90	0.66	0.5
G12110266-014	10, 42-60 in.	34	0.3	12	54	26	20	SCL	7.6	0.6	3.77	1.11	1.03	0.7
G12110266-015	12, 0-9 in.	26	0.6	< 2	68	18	14	SL	7.2	0.5	3.24	1.31	0.36	0.2
G12110266-016	12, 9-20 in.	25	0.3	< 2	74	14	12	SL	7.5	0.4	2.31	1.00	0.48	0.4
G12110266-017	12, 20-26 in.	23	< 0.2	2	78	14	8	SL	7.8	0.7	2.26	1.20	2.47	1.9
G12110266-018	13, 0-5 in.	26	1.0	7	62	26	12	SL	7.0	0.6	3.19	1.40	0.51	0.3
G12110266-019	13, 5-13 in.	27	0.7	9	62	22	16	SL	7.5	0.6	3.54	1.44	0.98	0.6
G12110266-020	13, 13-17 in.	27	0.8	9	64	24	12	SL	7.2	0.7	4.02	1.67	0.95	0.6
G12110266-021	15, 0-12 in.	26	0.6	3	62	22	16	SL	6.6	0.6	2.93	1.22	0.36	0.2
G12110266-022	15, 12-16 in.	26	0.3	12	68	18	14	SL	7.2	0.6	3.15	1.30	0.53	0.4
G12110266-023	17, 0-6 in.	26	0.6	7	68	16	16	SL	6.8	0.7	4.22	1.77	0.45	0.3
G12110266-024	17, 6-16 in.	27	0.4	4	72	12	16	SL	7.3	0.5	3.14	1.36	0.43	0.3
G12110266-025	17, 16-20 in.	26	0.3	7	74	12	14	SL	7.5	0.5	3.10	1.41	0.56	0.4
G12110266-026	18, 0-10 in.	29	0.5	3	66	17	18	SL	7.2	0.5	3.06	1.12	0.50	0.4
G12110266-027	18, 10-18 in.	31	0.3	16	68	16	16	SL	7.3	0.8	3.34	1.36	2.20	1.4
G12110266-028	101, 0-3 in.	27	0.4	< 2	70	14	16	SL	6.6	0.2	1.17	0.46	0.24	0.3
G12110266-029	101, 3-10 in.	30	0.3	< 2	68	20	12	SL	7.2	0.5	2.66	0.84	0.32	0.2
G12110266-030	101, 10-24 in.	30	0.4	< 2	68	18	14	SL	7.6	0.5	2.71	0.90	0.84	0.6
G12110266-031	102, 0-14 in.	28	1.1	4	60	26	14	SL	6.3	0.4	2.77	1.17	0.24	0.2
G12110266-032	102, 14-24 in.	24	0.3	8	54	30	16	SL	6.9	0.3	1.95	0.89	0.29	0.2
G12110266-033	102, 24-34 in.	32	0.4	4	52	28	20	L	7.0	0.3	1.63	0.71	0.36	0.3
G12110266-034	102, 34-46 in.	34	0.3	< 2	54	26	20	SCL	7.5	0.4	2.69	1.15	0.55	0.4
G12110266-035	102, 46-57 in.	35	0.4	< 2	56	26	18	SL	7.7	0.6	4.07	2.08	0.72	0.4
G12110266-036	103, 0-10 in.	27	0.8	4	68	20	12	SL	6.7	0.4	2.43	1.05	0.27	0.2
G12110266-037	103, 10-20 in.	25	0.9	9	68	16	16	SL	7.2	0.5	3.03	1.28	0.39	0.3
G12110266-038	103, 20-26 in.	24	0.5	7	72	16	12	SL	7.4	0.5	3.41	1.48	0.43	0.3
G12110266-039	103, 26-46 in.	24	< 0.2	11	78	12	10	SL	7.7	0.7	3.46	1.97	1.39	0.8
G12110266-040	104, 0-10 in.	25	0.6	8	66	20	14	SL	8.9	0.4	2.29	0.98	0.35	0.3
G12110266-041	104, 10-18 in.	22	0.5	14	72	16	12	SL	7.3	0.5	3.35	1.48	0.55	0.4
G12110266-042	104, 18-32 in.	21	0.3	19	68	22	10	SL	7.8	0.5	3.02	1.67	1.01	0.7

LABORATORY ANALYTICAL REPORT
Prepared by Gillette, WY Branch

Client: Lidstone and Associates
Project: Lost Creek East Uranium
Workorder: G12110266

Report Date: 12/18/12
Date Received: 11/12/12

Analysis		SAT	OM-WB	Coarse Fragments	Sand	Silt	Clay	Texture	pH-SatPst	COND	Ca-SatPst	Mg-SatPst	Na-SatPst	SAR-sat paste
Units		wt%	%	%	%	%	%	%	s_u_	mmhos/cm	meq/L	meq/L	meq/L	unitless
Sample ID	Client Sample ID	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
G12110266-043	104, 32-45 in.	21	< 0.2	18	70	16	14	SL	8.3	1.0	1.86	1.32	6.90	5.5
G12110266-044	105, 0-12 in.	25	0.7	4	74	14	12	SL	8.8	0.4	2.86	1.08	0.28	0.2
G12110266-045	105, 12-30 in.	23	0.3	14	76	12	12	SL	7.3	0.5	2.98	1.22	0.59	0.4
G12110266-046	105, 30-35 in.	24	0.3	8	80	10	10	SL	7.6	0.7	4.50	1.93	0.68	0.4
G12110266-047	106, 0-6 in.	23	0.8	< 2	80	12	8	LS	7.4	0.5	3.82	1.32	0.28	0.2
G12110266-048	106, 6-14 in.	21	0.5	< 2	84	8	8	LS	7.5	0.4	3.01	1.09	0.32	0.2
G12110266-049	106, 14-34 in.	21	< 0.2	< 2	86	6	8	LS	7.8	0.4	2.28	0.82	0.41	0.3
G12110266-050	106, 34-46 in.	19	0.2	< 2	88	6	6	LS	7.9	0.4	2.57	1.05	0.57	0.4
G12110266-051	107, 0-3 in.	28	1.3	< 2	80	6	14	SL	6.3	0.2	1.51	0.66	0.16	0.2
G12110266-052	107, 3-14 in.	28	0.9	< 2	52	34	14	L	6.7	0.4	2.85	1.17	0.25	0.2
G12110266-053	107, 14-26 in.	21	0.5	< 2	68	20	12	SL	6.6	0.2	1.06	0.50	0.23	0.3
G12110266-054	107, 26-34 in.	20	0.3	< 2	76	14	10	SL	7.0	0.1	0.72	0.34	0.24	0.3
G12110266-055	107, 34-42 in.	24	0.3	3	74	16	10	SL	6.9	0.2	1.31	0.59	0.32	0.3
G12110266-056	107, 42-60 in.	22	0.2	< 2	78	14	8	SL	7.1	0.2	1.19	0.55	0.36	0.4
G12110266-057	111, 0-4 in.	23	0.8	4	70	14	16	SL	6.7	0.4	2.45	1.02	0.38	0.3
G12110266-058	111, 4-12 in.	24	0.8	12	66	20	14	SL	6.6	0.4	2.14	0.89	0.75	0.6
G12110266-059	111, 12-24 in.	40	0.5	< 2	42	38	20	L	7.4	0.6	2.42	0.80	2.72	2.1
G12110266-060	113, 0-12 in.	26	0.8	3	64	22	14	SL	7.0	0.6	3.98	1.46	0.36	0.2
G12110266-061	113, 12-20 in.	22	0.8	4	68	18	14	SL	7.4	0.5	3.82	1.39	0.37	0.2
G12110266-062	113, 20-26 in.	25	0.7	4	74	14	12	SL	7.5	1.1	6.73	2.75	0.70	0.3
G12110266-063	113, 26-46 in.	25	0.4	12	78	8	14	SL	7.8	1.2	3.44	2.04	4.45	2.7

LABORATORY ANALYTICAL REPORT
Prepared by Gillette, WY Branch

Client: Lidstone and Associates
Project: Lost Creek East Uranium
Workorder: G12110266

Report Date: 12/18/12
Date Received: 11/12/12

	Analysis	B	Selenium
	Units	mg/kg	mg/kg
Sample ID	Client Sample ID	Results	Results
G12110266-001	1, 0-17 in.	0.1	< 0.1
G12110266-002	1, 17-28 in.	0.2	< 0.1
G12110266-003	1, 28-36 in.	0.2	< 0.1
G12110266-004	2, 0-12 in.	0.1	< 0.1
G12110266-005	2, 12-22 in.	< 0.1	< 0.1
G12110266-006	6, 0-12 in.	< 0.1	< 0.1
G12110266-007	6, 12-24 in.	< 0.1	< 0.1
G12110266-008	6, 24-47 in.	< 0.1	< 0.1
G12110266-009	10, 0-5 in.	0.2	< 0.1
G12110266-010	10, 5-12 in.	0.3	< 0.1
G12110266-011	10, 12-28 in.	0.2	< 0.1
G12110266-012	10, 28-36 in.	0.2	< 0.1
G12110266-013	10, 36-42 in.	0.1	< 0.1
G12110266-014	10, 42-60 in.	0.1	< 0.1
G12110266-015	12, 0-9 in.	0.2	< 0.1
G12110266-016	12, 9-20 in.	0.2	< 0.1
G12110266-017	12, 20-36 in.	0.2	< 0.1
G12110266-018	13, 0-5 in.	0.3	< 0.1
G12110266-019	13, 5-13 in.	0.5	< 0.1
G12110266-020	13, 13-17 in.	0.3	< 0.1
G12110266-021	15, 0-12 in.	0.1	< 0.1
G12110266-022	15, 12-16 in.	< 0.1	< 0.1
G12110266-023	17, 0-6 in.	0.1	< 0.1
G12110266-024	17, 6-16 in.	< 0.1	< 0.1
G12110266-025	17, 16-20 in.	< 0.1	< 0.1
G12110266-026	18, 0-10 in.	< 0.1	< 0.1
G12110266-027	18, 10-18 in.	0.1	< 0.1
G12110266-028	101, 0-3 in.	< 0.1	< 0.1
G12110266-029	101, 3-10 in.	< 0.1	< 0.1
G12110266-030	101, 10-24 in.	0.1	< 0.1
G12110266-031	102, 0-14 in.	0.2	< 0.1
G12110266-032	102, 14-24 in.	0.2	< 0.1
G12110266-033	102, 24-34 in.	0.3	< 0.1
G12110266-034	102, 34-46 in.	0.2	< 0.1
G12110266-035	102, 46-57 in.	0.2	< 0.1
G12110266-036	103, 0-10 in.	< 0.1	< 0.1
G12110266-037	103, 10-20 in.	< 0.1	< 0.1
G12110266-038	103, 20-26 in.	< 0.1	< 0.1
G12110266-039	103, 26-46 in.	< 0.1	< 0.1
G12110266-040	104, 0-10 in.	0.1	< 0.1
G12110266-041	104, 10-18 in.	0.1	< 0.1
G12110266-042	104, 18-32 in.	< 0.1	< 0.1

]
WDEQ-LQD LC East Amendment
Original D7-62

LABORATORY ANALYTICAL REPORT
Prepared by Gillette, WY Branch

Client: Lidstone and Associates
Project: Lost Creek East Uranium
Workorder: G12110266

Report Date: 12/18/12
Date Received: 11/12/12

	Analysis	B	Selenium
	Units	mg/kg	mg/kg
Sample ID	Client Sample ID	Results	Results
G12110266-043	104, 32-45 in.	0.1	< 0.1
G12110266-044	105, 0-12 in.	0.1	< 0.1
G12110266-045	105, 12-30 in.	< 0.1	< 0.1
G12110266-046	105, 30-55 in.	< 0.1	< 0.1
G12110266-047	106, 0-6 in.	0.2	< 0.1
G12110266-048	106, 6-14 in.	0.2	< 0.1
G12110266-049	106, 14-34 in.	< 0.1	< 0.1
G12110266-050	106, 34-46 in.	< 0.1	< 0.1
G12110266-051	107, 0-3 in.	< 0.1	< 0.1
G12110266-052	107, 3-14 in.	< 0.1	< 0.1
G12110266-053	107, 14-26 in.	< 0.1	< 0.1
G12110266-054	107, 26-34 in.	< 0.1	< 0.1
G12110266-055	107, 34-42 in.	< 0.1	< 0.1
G12110266-056	107, 42-60 in.	< 0.1	< 0.1
G12110266-057	111, 0-4 in.	< 0.1	< 0.1
G12110266-058	111, 4-12 in.	< 0.1	< 0.1
G12110266-059	111, 12-24 in.	< 0.1	< 0.1
G12110266-060	113, 0-12 in.	0.1	< 0.1
G12110266-061	113, 12-20 in.	0.2	< 0.1
G12110266-062	113, 20-26 in.	0.2	< 0.1
G12110266-063	113, 26-46 in.	0.1	< 0.1

]
WDEQ-LQD LC East Amendment
Original D7-63

ADDENDUM D7-1-E
PRIME FARMLAND DESIGNATION

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
79 Winston Drive, Suite 235
Rock Springs, WY 82901

Lisa Cox
BKS Environmental Associates, Inc.
724 Dewar Drive
Rock Springs, Wyoming 82901

March 8, 2013

RE: Prime Farmland Designation for Lost Creek Project

Dear Ms. Cox:

Recently you requested soil survey information for the Lost Creek project. Your project area is located approximately 50 miles northwest of Rawlins, Wyoming and is located in Sweetwater County, Wyoming. It includes all of or portions of sections 1,2,3,10,11,14,15,20,21,22,23,27,28, and 29 of Township 25N, Range 92W.

I regret to inform you that there is currently no soil mapping completed in the area described. As such, we have not designated any of that land as Prime Farmland. Please keep in mind that this does not necessarily mean the area does not contain any Prime Farmland, but that at this time we simply have not assessed its suitability due to lack of documentation.

Please contact the Rock Springs MLRA Soil Survey Office at (307) 362-3062 if you have any further questions regarding this matter.

Sincerely,

Jason Martin
MLRA Soil Survey Leader, Rock Springs, WY

ADDENDUM D7-1-F
PHOTOGRAPHS

Photo 1. Profile view of Sample Point #1

Photo 2. General view of Sample Point #1

Photo 3. Profile view of Sample Point #2

Photo 4. General view of Sample Point #2

Photo 5. Profile view of Sample Point #6

Photo 6. General view of Sample Point #6

Photo 7. Profile view of Sample Point # 10

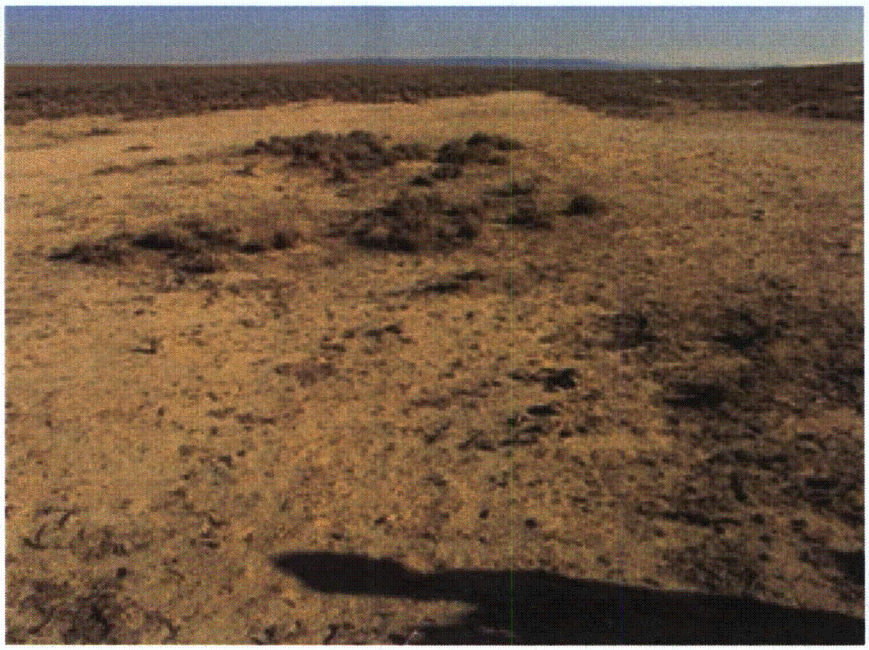

Photo 8. General view of Sample Point #10

Photo 9. Profile view of Sample Point #12

Photo 10. General view of Sample Point #12

Photo 11. Profile view of Sample Point #13

Photo 12. General view of Sample Point #13

Photo 13. Profile view of Sample Point #15

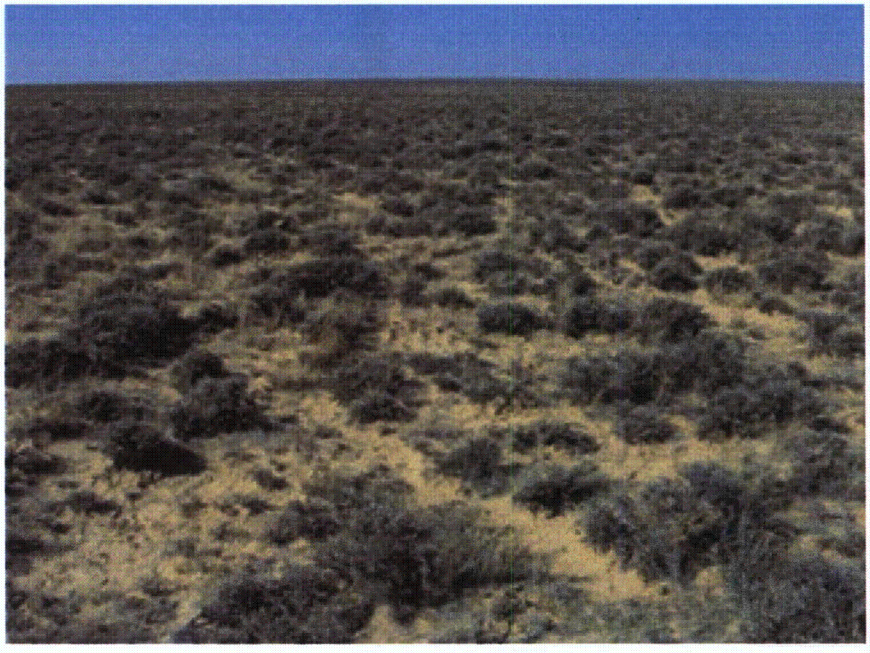

Photo 14. General view of Sample Point #15

Photo. 15. Profile view of Sample Point #17

Photo 16. General view of Sample Point #17

Photo 17. Profile view of Sample Point #18

Photo 18. General view of Sample Point #18

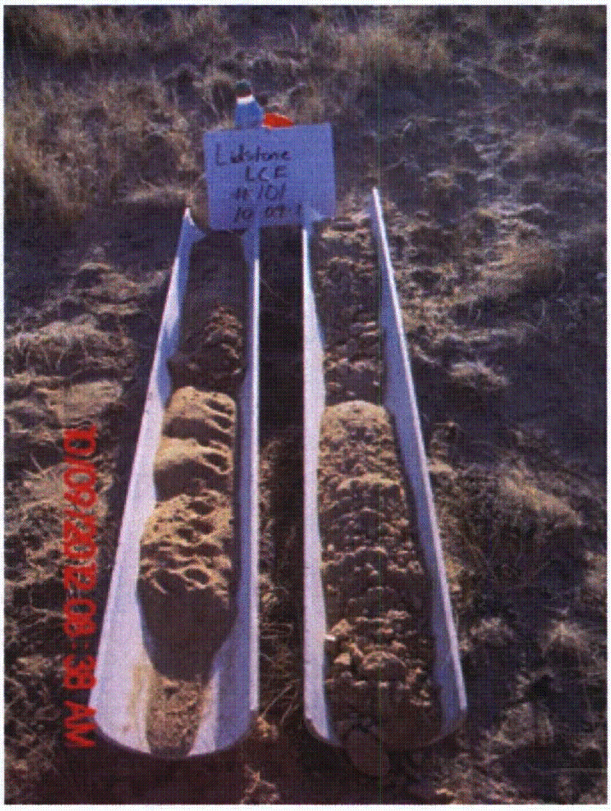

Photo 19. Profile view of Sample Point #101

Photo 20. General view of Sample Point #101

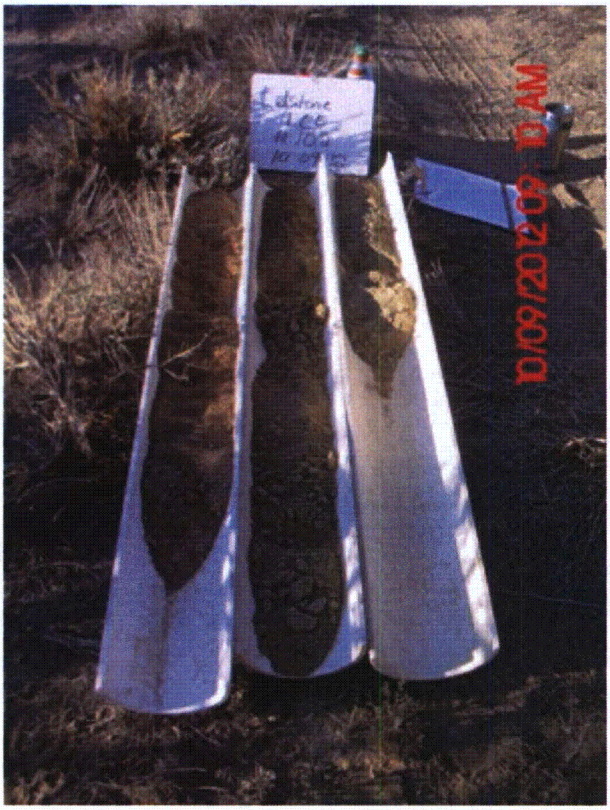

Photo 21. Profile view of Sample Point #102

Photo 22. General view of Sample Point #102

Photo 23. Profile view of Sample Point #103

Photo 24. General view of Sample Point #103

Photo 25. Profile view of Sample Point #104

Photo 26. General view of Sample Point #104

Photo 27. Profile view of Sample Point #105

Photo 28. General view of Sample Point #105

Photo 29. Profile view of Sample Point #106

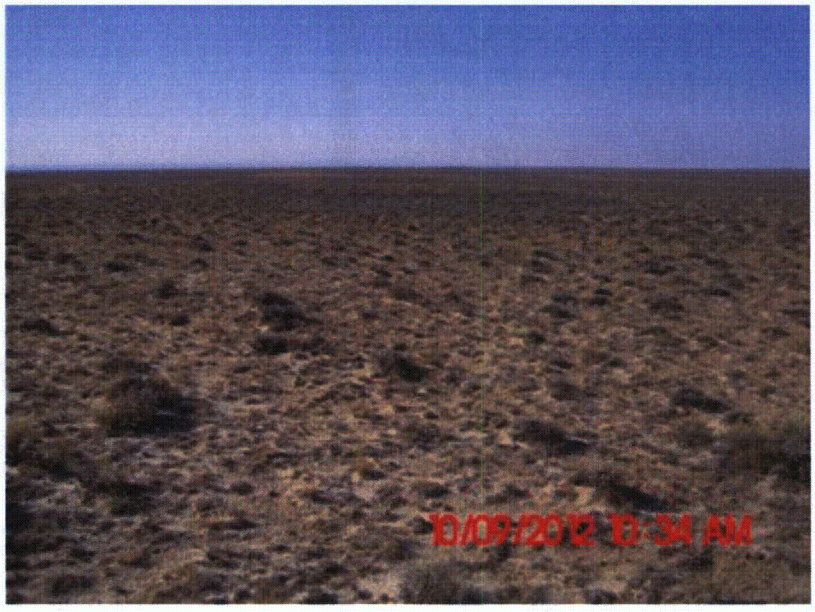

Photo 30. General view of Sample Point #106

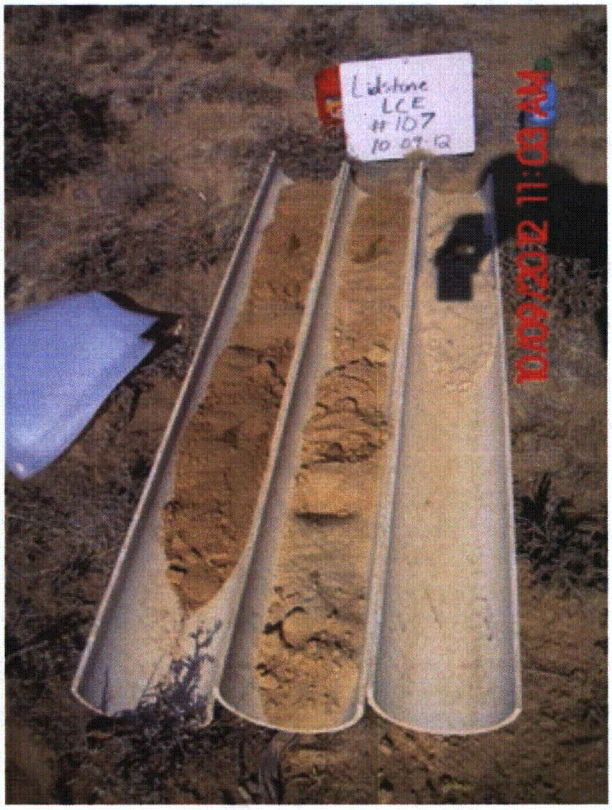

Photo 31. Profile view of Sample Point #107

Photo 32. General view of Sample Point #107

Photo 33. Profile view of Sample Point #111

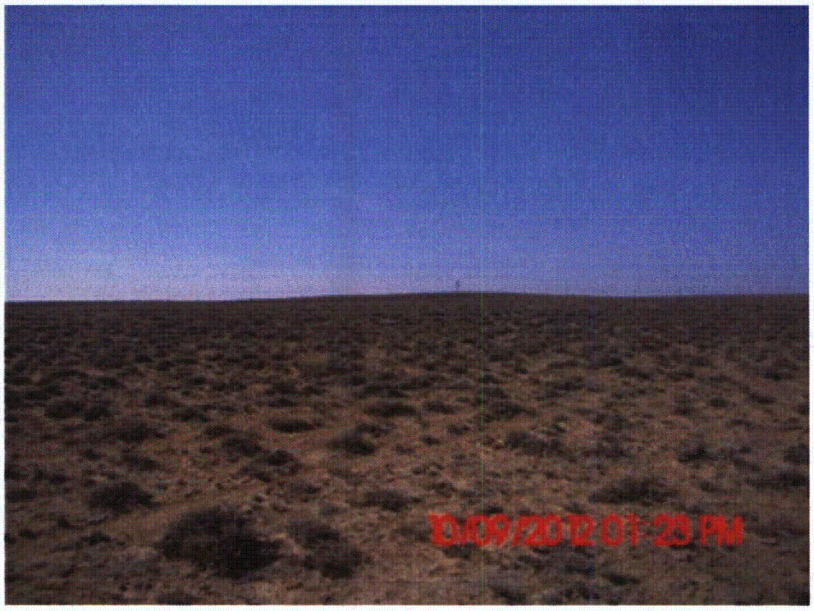

Photo 34. General view of Sample Point #111

Photo 35. Profile view of Sample Point #113

Photo 36. General view of Sample Point #113

ADDENDUM D7-1-G
MAP

The 11 drawings specifically referenced in the table of contents have been processed into ADAMS.

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

D01 – D11

APPENDIX D8-1

LOST CREEK EAST AMENDMENT AREA
2013 BASELINE VEGETATION ASSESSMENT

Prepared for:

Lost Creek ISR, LLC
5880 Enterprise Dr., Suite 200
Casper, WY 82609

Prepared by:

BKS Environmental Associates, Inc.
P.O. Box 3017
Rock Springs, Wyoming 82902

August 2013

ADDENDUM D8-1
TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

D8-1 VEGETATION

D8-1.1 Introduction

This report presents the results of vegetation studies conducted on the Lost Creek East Amendment Area to the Lost Creek East ISR Uranium Mine (WDEQ Permit No. 788) on October 8, 2012 and June 26-27, 2013. The sampling methodology for the project follows the information presented in the Wyoming Department of Environmental Quality (WDEQ) – Land Quality Division (LQD) Guideline No. 2 – Vegetation for Non-Coal Operations. Prior to the initiation of field work for the project, the sampling methodology was reviewed and accepted by Craig Smith of the WDEQ-LQD. The sampling methodology is presented in Attachment D8-1.1 of this report. The vegetation sampling was completed by BKS Environmental Associates, Inc. of Gillette, Wyoming.

D8-1.2 Description of the Study Area

The Amendment Area is located near the center of the Great Divide Basin within Sweetwater County approximately 50 miles north of Rawlins, Wyoming. The elevation is approximately 7,000 feet above mean sea level. The Amendment Area is located in all or portions of Sections 1, 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 27, 28, and 29, T25N, R92W. The Amendment Area encompasses approximately 5,724 acres. The Western Regional Climate Center (WRCC) meteorological station closest to the Amendment Area with a long period of record is the Muddy Gap, Wyoming station (WRCC 2013). This station is 28 miles northeast of the Amendment Area, and temperature, precipitation, snowfall, and snow depth data have been collected since 1949.

At Muddy Gap, the mean annual precipitation was 9.87 inches. The prevailing monthly wind direction was from the west-northwest and west for most of the year, with some variability occurring in the spring. The annual average wind speed at a height of ten meters was 20.7 feet per second (6.3 meters per second). Additionally, a Lost Creek (LC) meteorological station was installed in May 2007 within the Lost Creek Permit Area to collect on-site data. The LC station showed a mean annual precipitation of approximately 7.5 inches during 2007-2009.

Most of the Amendment Area consists of flat upland areas and gentle south facing slopes that are dissected by southerly-flowing ephemeral washes. There are no perennial streams on the Amendment Area. The vegetation is dominated by big sagebrush (*Artemisia tridentata*) which occurs throughout both upland and lowland areas. Big sagebrush is well adapted to the cold winter temperatures and limited precipitation that characterize

the Amendment Area. Numerous other species occur, but none are as successful as big sagebrush. Because of the differences in the density and stature of big sagebrush within the Lost Creek ISR Uranium Mine permit area and the Amendment Area, two sagebrush shrubland vegetation communities were identified and mapped: Upland Big Sagebrush Shrubland and Lowland Big Sagebrush Shrubland. These vegetation communities were defined on the basis of topographic position, with the Lowland Big Sagebrush vegetation community occurring in the deeper soils along the ephemeral drainages. Barren, wind-blown areas throughout the Amendment Area support Mixed Grass/Mat Cushion Grassland, but were not identified and mapped in the Lost Creek ISR Uranium Mine permit area.

Limited amounts of annual precipitation (less than ten inches) and freezing winter temperatures create a cold desert climate which tends to restrict vegetation development. Plant communities tend to be dominated by shrubs, cushion plants, or cacti rather than by herbaceous species.

D8-1.3 Methods

D8-1.3.1 Vegetation Community Mapping

Vegetation community mapping was conducted on October 8, 2012. Three vegetation communities were identified within the Amendment Area: Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland. Vegetation communities were mapped using 2011 U.S. Department of Agriculture National Agricultural Imagery Program (NAIP) true color ortho aerial imagery and verified through field surveys. Disturbed areas and water present within the Amendment Area were also identified and mapped, based on the scale of the available mapping.

All areas within ½ mile of the Amendment Area were mapped based on review of NAIP true color ortho aerial imagery and known expression of the NAIP true color ortho aerial imagery within the Amendment Area, based on the October 2012 field surveys. Field verification of the vegetation communities within the ½ mile buffer was not necessary, and vegetation sampling was not conducted within the ½ mile buffer.

D8-1.3.2 Selection of Sample Point Locations

A computerized systematic grid (through ArcGIS) was used to randomly locate 50 sample points within each vegetation community occurring within the Amendment Area. These computer generated random locations were uploaded to a hand-held Global Positioning System (GPS) unit for actual location in the field. Sample points were sampled in numerical order until the minimum sample size was attained and then,

until either sample adequacy was met or the required maximum number of samples had been collected. Disturbed areas were excluded from sampling.

D8-1.3.3 Sample Intensity and Sample Site Location

A total of 69 points were sampled within the Amendment Area. Twenty points were sampled within the Lowland Big Sagebrush Shrubland, and twenty points were sampled within the Upland Big Sagebrush Shrubland vegetation communities. Twenty-nine points were sampled within the Mixed Grass/Mat Cushion Grassland vegetation community. Sample site locations are shown on the Amendment Area vegetation map (Figures D8-1.1, D8-1.2, and D8-1.3).

D8-1.3.4 Cover Sampling of Vegetation Communities

Line-transect point-intercept methods were used to collect percent absolute cover data within the Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities. Percent cover measurements were taken from point-intercepts at one-meter intervals along a 50-meter cover transect using a laser point device at each sample location. Each 50-meter point-intercept cover transect began at its specified random origin point and extended in a random compass direction. Transects that exceeded the boundaries of the vegetation community being sampled were redirected back into its vegetation community at a 90 degree angle from the original transect direction at the point of intercept. In instances where a 90 degree angle of reflection did not place the cover transect within the sampled vegetation community, a 45 degree angle of reflection was used.

Each 50-meter cover transect represented a single sample point within the given vegetation community. Each point-intercept represented 2% of the cover measurement. Percent cover measurements recorded "first-hit" point-intercepts by live foliar vegetation species, litter, rock, or bare ground. "Second-hits" on vegetation were recorded, but used only for the purpose of constructing a plant species list for each vegetation community. Percent vegetation cover is the vertical projection of the general outline of plants to the ground surface. All "first-hit" point-intercepts of living vegetation and growth, produced during the current growing season and cryptograms were counted toward total vegetation cover. Total vegetation cover data was summarized by computing absolute (mean) cover, relative cover (% of total vegetation cover), frequency, and relative frequency (% of total plot occurrences for each plant species).

Total ground cover equals the sum of cover values for percent vegetation, percent litter, and percent rock. Litter included all non-living organic material that is recognizable.

Rock fragments were recorded when equal to or greater than one-square centimeter in size (i.e., sheet flow, minimum non-erodible particle size). Total ground cover measurements were expressed in absolute percentages for each sample point.

D8-1.3.5 Shrub and Tree Density

Although shrub density sampling is not required for non-coal sites, this data was collected in conjunction with the cover sampling. Shrub density sampling was accomplished by counting each individual full, sub, and half shrub located within one meter of either side of the 50-meter cover transect (100-square meter belt transect). The number of individual shrub occurrences was recorded by species. The number of shrub density belt transects equaled the number of 50-meter cover transects within each vegetation community. Data was tabulated by computing the mean density per square meter and mean density per acre. Sample adequacy was not calculated for shrub density transects. General approximations of shrub heights were recorded; however, shrub height measurements were not summarized for purposes of this report. No trees were encountered.

D8-1.3.6 Species Diversity and Composition

Species diversity was assessed by recording all plant species observed within the same 100-square meter belt transect used for determining shrub density. These observations provide a measurement of the total species diversity for each vegetation community. Species diversity data was reported as the average number of species per 100-square meter belt transect and total number of species within each vegetation community, based on the 2013 field survey. The total number of species with greater than 2% relative vegetation cover within each vegetation community was also determined. Species diversity calculations did not include Species Lacking Credible Value (SLCV): halogeton (*Halogeton glomeratus*), Japanese brome (*Bromus japonicus*), cheatgrass (*Bromus tectorum*), summer cypress (*Bassia sieversiana*), and Russian thistle (*Salsola tragus*), Wyoming State Designated Noxious Weeds, or Sweetwater County Declared Weeds. The number of species diversity belt transects equaled the number of 50-meter cover transects within each vegetation community.

A comprehensive plant species list was compiled from plant species encountered during 2012 vegetation mapping and 2013 quantitative vegetation sampling. The plant species list includes plant species sampled in cover transects, as well as plant species observed along the belt transect. Species observed during vegetation community mapping, threatened and endangered habitat and plant species surveys, wetland surveys, and plant species survey. Plant species were compiled by lifeform and vegetation community. Scientific nomenclature follows the Rocky Mountain Vascular Plants of Wyoming (Dorn, 3rd Edition).

D8-1.3.7 Sample Adequacy

Sample adequacy was tested for each of the sampled vegetation communities, using the following formula:

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

Where n_{min} = the number of sample points needed in a given vegetation community
s = sample standard deviation
z = 1.28 from WDEQ Guideline 2
d = 0.1 from WDEQ Guideline 2
x = sample mean for total vegetation cover or total ground cover

Confidence levels were determined as outlined in WDEQ-LQD Guideline 2.

D8-1.3.8 Extended Reference Area

For the purposes of this permit application, Extended Reference Area (EXREFA) means a native land unit which will be used to evaluate revegetation success for each of the same native vegetation communities which were affected by the mining operation. All Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities unaffected by the mining operation, within the permit area of the Lost Creek ISR Uranium Mine and/or the Amendment Area, will serve as the EXREFA. The EXREFA will remain unaffected over the course of the mining operation and will be as large as practical, at least two acres, considering land ownership patterns and land management history. One EXREFA, for each of the native vegetation communities affected by the mining operations, will be used to evaluate revegetation success within the Lost Creek ISR Uranium Mine and the Amendment Area.

D8-1.3.9 Cropland and Hayland Productivity

There are no croplands within the Amendment Area. The area is used for livestock grazing, but no crops are produced. In addition to grazing by domestic livestock (cattle), wild horses, pronghorn, and other wildlife graze the Amendment Area.

D8-1.4 Results

D8-1.4.1 Description of Vegetation Communities

The Amendment Area is located in the Great Divide Basin, where the vegetation on upland areas is consistently dominated by big sagebrush. The vegetation development within the Amendment Area is consistent with these regional patterns. Within the Amendment Area, two vegetation communities dominated by big sagebrush (*Artemisia tridentata*) and one dominated by graminoids and cushion plants were identified and mapped (Figures D8-1.1, D8-1.2, and D8-1.3). The areal extent of each of these vegetation communities are presented in Table D8-1.1. In the sections that follow, each vegetation community is described based on data collected in June 2013 and on general observations made during vegetation community mapping.

D8-1.4.1.1 Upland Big Sagebrush Shrubland Vegetation Community

The Upland Big Sagebrush Shrubland vegetation community comprised approximately 5,370 of the 5,724 acre Amendment Area (93.8%) (Table D8-1.1). This vegetation community was generally found on shallow, coarse-textured soils within the Amendment Area. Within this vegetation community there were rolling hills and long moderately steep to gently sloping hillsides. These long hillsides create rolling topography, often extending from ridgetops to edges of ephemeral drainages (Figure D8-1.4).

Native full shrubs were the dominant lifeform within the Upland Big Sagebrush Shrubland vegetation community. Common shrub species included big sagebrush and sticky-leaved rabbitbrush (*Chrysothamnus viscidiflorus*). These species were also present within the Lowland Big Sagebrush Shrubland vegetation community; however, within the Upland Big Sagebrush Shrubland the shrubs were smaller is size due to shallow soils and harsh winter conditions. Grass and forb species were also observed within this vegetation community, but not as abundantly as shrubs.

Cover

Twenty, 50-meter cover transects were sampled within this vegetation community in 2013. Absolute total vegetation cover was 30.5% (Table D8-1.2). Absolute bare soil, litter, and rock percentages were 45.8%, 22.2%, and 1.5%, respectively. Absolute total ground cover was 54.2%. Native full shrubs were the dominant lifeform with 62.6% relative vegetation cover, followed by native cool season perennial grasses with 18.0%

relative vegetation cover. Big sagebrush provided the highest relative vegetation cover at 61.6%, while Hoods phlox (*Phlox hoodii*) provided the next highest relative vegetation cover at 8.2%. Raw data is presented in Table 1 of Attachment D8-1.2.

Shrub and Tree Density

Shrub density within the Upland Big Sagebrush Shrubland vegetation community was 3.0 shrubs/square meter or 12,074 shrubs/acre (Table D8-1.3). Big sagebrush was the dominant shrub species. Raw data is presented in Table 2 of Attachment D8-1.2. No trees were observed within the Upland Big Sagebrush Shrubland vegetation community.

Species Diversity and Composition

Six lifeforms and 24 plant species were observed within the Upland Big Sagebrush Shrubland vegetation community (Table D8-1.8). The mean number of plant species observed per belt transect was 7.9. Native cool season perennial grasses were the most common lifeform encountered with nine plant species observed. Native perennial forbs were the second most common lifeform with seven plant species observed. Raw data is presented in Table 1 of Attachment D8-1.2.

D8-1.4.1.2 Lowland Big Sagebrush Shrubland Vegetation Community

The Lowland Big Sagebrush Shrubland vegetation community comprised approximately 325 of the 5,724 acre Amendment Area (5.7%) (Table D8-1.1). This vegetation community was generally found on deep coarse-textured soils in or surrounding ephemeral drainages within the Amendment Area, generally crossing the Amendment Area from north to south. The increased potential soil moisture allows greater growth by shrub species; therefore, individual shrubs occurring within and along the drainages tended to be much larger than the shrubs occurring on the upland areas (Figure D8-1.5).

Native full shrubs were the dominant lifeform within the Lowland Big Sagebrush Shrubland vegetation community. Common native full shrub species included big sagebrush, sticky-leaved rabbitbrush, and rubber rabbitbrush (*Ericameria nauseosa*). Big sagebrush and sticky-leaved rabbitbrush were also present within the Upland Big Sagebrush Shrubland vegetation community; however, the densities and size of individual plants was distinctly different between the two communities. Grass and forb species were also observed within this vegetation community, but not as abundantly as shrubs.

Cover

Twenty, 50-meter cover transects were sampled within this vegetation community in

2013. Absolute total vegetation cover was 41.8% (Table D8-1.4). Absolute bare soil and litter percentages were 20.7% and 37.5%, respectively. Absolute total ground cover was 79.3%. Native full shrubs were the dominant lifeform with 88.8% relative vegetation cover, followed by native cool season perennial grasses with 8.4% relative vegetation cover. Big sagebrush provided the highest relative vegetation cover at 79.2%, while rubber rabbitbrush provided the next highest relative vegetation cover at 5.5%. Sandberg bluegrass (*Poa secunda*) provided 3.1% relative cover. Raw data is presented in Table 3 of Attachment D8-1.2.

Shrub and Tree Density

Shrub density within the Lowland Big Sagebrush Shrubland vegetation community was 2.9 shrubs/square meter or 11,738 shrubs/acre (Table D8-1.5). Big sagebrush was the dominant shrub species. Raw data is presented in Table 4 of Attachment D8-1.2. No trees were observed within the Lowland Big Sagebrush Shrubland vegetation community.

Species Diversity and Composition

Nine lifeforms and 29 plant species were observed within the Lowland Big Sagebrush Shrubland vegetation community (Table D8-1.8). The mean number of plant species observed per belt transect was 6.65. Native cool season perennial grasses were the most common lifeform encountered with 10 plant species observed. Native perennial forbs were the second most common lifeform with six plant species observed. Raw data is presented in Table 3 of Attachment D8-1.2.

D8-1.4.1.3 Mixed Grass/Mat Cushion Grassland Vegetation Community

The Mixed Grass/Mat Cushion Grassland vegetation community comprised approximately 27.04 of the 5,724.36 acre Amendment Area (0.47%) (Table D8-1.1). This vegetation community was generally found in coarse-textured soils. Within this vegetation community there were exposed sandy hilltops and eroded areas on hillsides. These eroded areas on hillsides create depressions within the landscape with limited vegetation and more bare ground than surrounding areas (Figure D8-1.6).

Native perennial forbs were the dominant lifeform within the Mixed Grass/Mat Cushion Grassland vegetation community. Common perennial forb species included Hoods phlox, stemless goldenweed (*Stenotus acaulis*), and musk phlox (*Phlos muscoides*). Shrub species were generally scattered within this vegetation community and included big sagebrush, rubber rabbitbrush, and winterfat (*Krascheninnikovia lanata*).

Cover

Twenty-nine, 50-meter cover transects were sampled within this vegetation community in 2013. Absolute total vegetation cover was 19.7% (Table D8-1.6). Absolute bare soil, litter, and rock percentages were 64.1%, 15.2%, and 1.0%, respectively. Absolute total ground cover was 35.9%. Native perennial forbs were the dominant lifeform with 33.7% relative vegetation cover, followed by native cool season perennial grasses with 23.8% relative vegetation cover. Hoods phlox provided the highest relative vegetation cover at 16.9%, while big sagebrush provided the next highest relative vegetation cover at 16.5%. Raw data is presented in Table 5 of Attachment D8-1.2.

Shrub and Tree Density

Shrub density within the Mixed Grass/Mat Cushion Grassland vegetation community was 0.6 shrubs/square meter or 2,434 shrubs/acre (Table D8-1.7). Big sagebrush was the dominant shrub species. Raw data is presented in Table 6 of Attachment D8-2. No trees were observed within the Mixed Grass/Mat Cushion Grassland vegetation community.

Species Diversity and Composition

Eight lifeforms and 27 plant species were observed within the Mixed Grass/Mat Cushion Grassland vegetation community (Table D8-1.8). The mean number of plant species observed per belt transect was 8.1. Native perennial forbs were the most common lifeform encountered with 10 plant species observed. Native cool season perennial grasses were the second most common lifeform with seven plant species observed. Raw data is presented in Table 5 of Attachment D8-1.2.

D8-1.4.2 Weeds, Selenium Indicators, Endangered and Threatened Species, and Species of Local Concern

Surveys for Wyoming State Designated Noxious Weeds (Wyoming Weed and Pest Council 2013) and Sweetwater County Declared Weeds (Wyoming Weed and Pest Council 2012) were conducted in conjunction with baseline vegetation mapping, sampling, and threatened and endangered plant species surveys (Table D8-1.9). No Noxious Weeds or Declared Weeds were observed during these surveys.

No selenium indicator species were sampled or observed within the Amendment Area.

No threatened, endangered or plant species of special concern were observed on the

Amendment Area (WYNDD 2013). A complete evaluation of rare plant species is presented in Attachment D8-1.3 of this report.

D8-1.4.3 Species Composition

As part of all field work, observations were made regarding the species composition in each of the vegetation communities (Table D8-1.8). Forty-three species were observed within the Amendment Area. Within the Upland Big Sagebrush Shrubland vegetation community, 24 species were observed or sampled, within the Lowland Big Sagebrush Shrubland vegetation community, 29 species were observed or sampled, and within the Mixed Grass/Mat Cushion Grassland vegetation community 27 species were observed or sampled. The relatively low number of species is a reflection of the overall homogeneity of the environmental conditions on the site.

D8-1.4.4 Sample Adequacy

Twenty, 50-meter cover transects were sampled within the Upland Big Sagebrush Shrubland and Lowland Big Sagebrush Shrubland vegetation communities. Twenty-nine, 50-meter cover transects were sampled within Mixed Grass/Mat Cushion Grassland vegetation community. The sample adequacy formula, outlined in WDEQ-LQD Guideline 2, was utilized to determine the minimum required size of the sample population. All vegetation communities met sample adequacy (Table D8-1.10).

D8-1.5 Discussion

The 5,724 acre Amendment Area consists of three vegetation communities: Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland. The Upland Big Sagebrush Shrubland was the dominant vegetation community and occupied 93.8% of the Amendment Area. Lowland Big Sagebrush Shrubland accounted for 5.7%, and Mixed Grass/Mat Cushion Grassland accounted for 0.5%. Previously disturbed areas accounted for <0.5%, and water accounted for <0.5% of the Amendment Area.

Total vegetation cover ranged from 19.7% to 41.8%. Total ground cover ranged from 35.9% to 79.3%. Species diversity ranged from 24 to 29 plant species across the vegetation communities, with a total of 43 plant species observed. The dominant shrub species was big sagebrush. Sandberg bluegrass and prairie junegrass (*Koeleria macrantha*) were the dominant perennial grasses. The dominant perennial forb species was Hoods phlox.

No threatened or endangered plant species habitat or individuals were encountered within the Amendment Area. No Wyoming State Designated Noxious Weeds or Sweetwater County Declared Weeds were observed.

The vegetation that occurs within the Amendment Area is typical and representative of the vegetation within the Great Divide Basin region, and is very similar to the vegetation observed in the original Lost Creek ISR Uranium Mine permit area. The major vegetation communities are dominated by big sagebrush which is the major species in the region. Overall, the Amendment Area tends to be very homogeneous. The lack of perennial streams and minimal topographic variation restricts the overall species diversity. No wetland areas occur, however, concentrated grazing was evident surrounding water developments within the Amendment Area and multiple ephemeral drainages dissect the Amendment Area.

The three vegetation communities tend to have distinct boundaries between them and can be distinguished on aerial imagery (Figures D8-1.1, D8-1.2, and D8-1.3). As the soil profile depths become shallower at the edge of the ephemeral drainages, the big sagebrush gradually become smaller and the overall character of the vegetation changes from lowland to upland as the vegetation cover decreases. The smallest big sagebrush plants occur on the hilltops, where the plants are subject to blowing ice and snow in the winter and the vegetation is dependent on the more shallow soil profiles.

D8-1.6 Conclusions

- Most of the vegetation on the Amendment Area is typical of the vegetation found throughout the Great Divide Basin and is similar to the vegetation observed within the original Lost Creek ISR Uranium Mine permit area.
- No Wyoming State Designated Noxious or Sweetwater County Declared weeds were noted within the Amendment Area.
- No selenium indicator species were observed within the Amendment Area.
- No plant species of special concern were observed on the Amendment Area.
- A total of 43 species were observed on the Amendment Area. Overall, the species composition consisted of species that would be expected in big sagebrush shrublands.
- The Upland Big Sagebrush Shrubland was composed of 30.5% total vegetation cover, 22.2% and 1.5% cover by litter and rock, respectively, and 45.8% bare soil.
- The Lowland Big Sagebrush Shrubland was composed of 41.8% total vegetation cover, 37.5% cover by litter, and 20.7% bare soil.
- The Mixed Grass/Mat Cushion Grassland was composed of 19.7% total vegetation cover, 15.2% and 1.0% cover by litter and rock, respectively, and 64.1% bare soil.

- Sample adequacy requirements were met for all vegetation communities sampled.

D8-1.7 References

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FIGURE D8-1.1

FIGURE D8-1.2

FIGURE D8-1.3

Figure D8-1.4 Photo of the Upland Big Sagebrush Shrubland Vegetation Community*

* Photo taken at 42° 9' 35.87"N; 107° 47' 26.44" W, June 2013

Figure D8-1.5 Photo of the Lowland Big Sagebrush Shrubland Vegetation Community*

* Photo taken at 42° 8' 25.11" N; 107° 48' 11.98" W, June 2013

Figure D8-1.6 Photo of Mixed Grass/Mat Cushion Grassland Vegetation Community *

* Photo taken at 42° 8' 30.04" N; 107° 46' 35.04" W, June 2013