APPENDIX D7 - SOILS

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D7-1E Soils Map
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APPENDIX D-7 SOIL ASSESSMENT

1.0 INTRODUCTION

This section describes the soils within the proposed Power Resources Gas Hills Project, which is located approximately 50 miles southeast of Riverton, Wyoming. The 1996 and 1997 fieldwork and report was completed by BKS Environmental Associates, Inc. of Gillette, Wyoming; the 1996 and 1997 laboratory analyses were completed by Energy Labs in Casper, Wyoming; and the acreage determinations were completed by BRS, Inc. for the December 1996 submittal, with minor revisions by BKS for the 1997 report.

This area has been previously surveyed on a large scale by the U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS), formerly the SCS. The major objective of the 1996-97 assessments was to define the existing topsoil resource within the proposed permit area by:

1. Verifying the existing NRCS Order 3 mapping and making changes where appropriate;
2) Identifying suitable stripping depths for each map unit within the proposed permit area; and,
3) Providing chemical data to ensure that the outlined suitable stripping depths are appropriate.

The mapping of the soil units and ISL mine units (potential disturbed lands), within the proposed permit area, are shown on Plates D7-1E and D7-1W (East and West). The base mapping used for the presentation of data is an approximate 1"=500' rectified aerial photo taken on August 24, 1996. Field mapping of soil units was completed on this base map. Total and potential disturbed acreages were measured on Plates D7-1E and D-1W and compared to total permit acreage determined from topographic mapping at the same scale. Distortion of the rectified photo due to the relief in the area created an approximate 3% error in the photo base and the acreages reported in Table 1 were adjusted accordingly.

2.0 METHODS

2.1 Review of Existing Literature

The soils in this portion of Fremont County and Natrona County were studied and mapped to an Order 3 scale by the USDA, NRCS, in Riverton and Casper, respectively. The recently published Eastern Fremont County survey was reviewed for the 1996 and 1997 fieldwork, and forms the basis for the mapping throughout appropriate portions of the proposed permit area. Natrona County mapping is generally in a loose-leaf format; appropriate sections of the extreme eastern portion of the permit area were covered by this mapping. NRCS mapping unit descriptions and series descriptions were reviewed for concurrence with designated units within the proposed permit area.

Of the NRCS typical profile locations within the Eastern Fremont County mapping, two are near the project area, i.e., Cragosen and Milren. The Cragosen typical profile location is in Section 16 T33 N R89W near Umetco.

The NRCS map unit descriptions and the NRCS soils series descriptions, are included as Addenda D7-4 and D7-5, respectively.

2.2. Soil Survey

Development of the proposed permit area soil map followed techniques and procedures of the National Cooperative Soil Survey. Guideline No. 1 (November 1984) of the Wyoming Department of Environmental Quality, Land Quality Division was followed wherever applicable during the fieldwork.

An initial reconnaissance of the proposed permit area in 1996 was used to familiarize field personnel with the soils in the general area and the existing Order 3 mapping. Soil profiles were examined on a widely scattered basis according to physiographic forms to determine which soils were likely to occur on specific landscape positions.

Following the general reconnaissance survey, approximate boundaries between the existing Order 3 map units were verified in 1996 and during additional sampling in 1997. Refer to the attached soil maps, Plates D7-1E and D7-1W. Actual soil boundaries were delineated in the field by exposing soil profiles to determine the nature and extent of soil series present on the proposed permit area. Soil map unit boundaries were delineated and/or verified in the field on a 1"=500' photographic map. Refer to Plates D7-1E and D7-1W for 1996/1997 verification points, as well as 1996/1997 soil sampling locations (for analysis). Refer to Addendum 2 for the field notes associated with these point and sample locations.

2.3. Field Sampling

No formal field sheets were compiled in 1996 for existing series verification points. The locations were recorded on the attached Plates D7-1E and D7-1W. Field sheets were compiled for those areas where samples were collected for analysis in 1996 and 1997. Soils were visually assessed by viewing backhoe pits in 1996 where the material was excavated to the paralithic contact or a visually estimated cutoff limit. Samples were gathered from an exposed wall after photographs were taken of the profile. In 1997, a truck-mounted Giddings or hand auger was used to view profiles. The physical, and when possible, the chemical natures of each horizon within the profile were noted in the field. No permanent markings of series verification or sampling points were placed.

2.4. Laboratory Analysis

Laboratory analysis was conducted on samples collected within the various map units that comprise the major portion of the disturbed area. In selected locations, full profiles were sampled, e.g., Site S. In 1996, samples were collected below the visually estimated cutoff limits for suitable topsoil. Visual characteristics denoting the probable bottom of suitable material included: paralithic contact; excess lime content; and questionable salts. Analyses generally followed WDEQ Guideline 1 Topsoil Suitability, Table I-2. Lime estimate analysis was also included in 1996 based on field results. In 1997, some surface samples were also included in similar analysis to verify suitability. Also, additional samples were collected in 1997 for reduced parameter analysis that included lime and neutralization potential, as well as texture including very fine sand percentages.

3. RESULTS AND DISCUSSION

3.1. Soil Survey - General

The soils that occur within the Permit Area are typical of the semiarid areas of the western United States. The greatest proportion of the upland soils are residual (i.e., developed in place) and are formed from weathered sedimentary bedrock. Most developed soils reflect the character of the bedrock. The areas of sandy and medium-textured friable soils are underlain by sandstone and loamstone, while the heavy clay soils are underlain by shale. These soils vary widely in both depth and the suitability of the material for topsoil, which depends primarily on the parent material from which the soils have formed.

The ephemeral stream channels of the permit area are characterized by alluvial soils. These soils are developed from a variety of material washed from the uplands and then redeposited along the stream courses. The soils formed in alluvium reflect the character of the weathered, transported material.

The soils are generally shallow near the Beaver Rim and deep within the wide valleys, which is characteristic of the northern portion of the proposed permit area. Generally, the depth of suitable material can be estimated from the landscape position, e.g., ridge vs. alluvial drainage. However, sometimes extensive suitable topsoil appears on an atypical landscape position, i.e., the south facing slope of the ridge within the southern half of Section 21. A more highly dissected landscape was evident in the southwestern portion of the permit area. The percent of finer material, clay or silt, was generally greater within this portion of the proposed permit area, as is the potential for runoff and subsequent erosion.

3.2. Soil Mapping Unit Interpretation

The map unit "M" was added to Plates D7-1E and D7-1W as an Unnamed Torrifluvent. It is located in surface areas that have been impounded and/or wet areas that were designated possible wetland vegetation types. Oftentimes, the impoundments were created from past road construction activity, where the culverts are nonexisting or dysfunctional. In these areas, the soil profile has been modified and the quality of the topsoil depends upon the amount of salinization. Due to the nature of these areas, disturbance from construction activity is unlikely. This map unit was sampled in 1997 as sample locations 130 and 131. Topsoil quality varies in these soils, as shown by the laboratory analyses, summarized on Table 2b.

The 1996 or 1997 mapping resulted in no additional mapping units within the Permit Area, however, the boundaries did change within and between mapping units. Numerous pedons were exposed during the mapping verification of the entire Permit Area. The 1996 and 1997

verification series locations and the sample locations, are noted on the attached soil survey map. The map unit acreages, which are based on the 1996-97 fieldwork, are provided in Table 1. The estimates of the potential disturbed acreage are also included in that table.

3.3. Evaluation of Soil Suitability as a Plant Growth Medium

Within the Permit Area, the suitability of soil as a plant growth medium is generally limited by physical factors. These include; sandy or high clay textures, and chemical factors such as high electrical conductivity (EC), sodium adsorption ratio (SAR), or pH. The marginal material is likely found in steep, shale sloped areas near the Beaver Rim, in its immediate outwash area or in lowland flats where salt accumulation may be a problem. Higher percentages of fine sands in designated areas would make them more susceptible to erosion or surface pavement production.

The most common visual characteristic that limits potential use as a plant growth medium appears to be lime content. Often there were strong to violent reactions with diluted hydrochloric acid noted in the field, especially at depths greater than approximately 18 inches. The shallower soils are often limited by the amount of cobble at or near the surface, high lime, and high clay or silt percentages. The deeper soils found within or near either current or prehistoric drainages contain large amounts of alluvial sand or cobble.

Three sample locations displayed particularly poor characteristics for a plant growth medium. Sample Point T contained high amounts of sodium (reflected in the high SAR's) and a large amount of fine material. Birdsfoot sagebrush was common at the surface near this sample location, which indicates a general high presence of salts in the profile. Sample Point 130 indicated relatively high saturation percentages, lime content, and neutralization potential. Sample Point 119 indicated high lime and a relatively high percentage of very fine sands. The overall series limitations are presented in Table 4.

Within Mine Unit No.3, the percentage of Rock Outcrop outlined in Table 5 is approximately 40%. Not every soil series within the Permit Area was sampled for suitability, depending on the extent of proposed disturbance and its extent within the entire area. The samples were concentrated within those series that were anticipated to be disturbed to the greatest degree.

Table 2 is a summary table denoting the laboratory analysis. The taxonomic classification of each of the sampled series is provided in Table 3. The actual laboratory sheets from Energy Laboratories in Casper are attached as Addendum D7-3.

3.4. Topsoil Protection

During the delineation drilling, the wellfield installation, and the monitor ring installation, the topsoil will be segregated and replaced contemporaneously. Following the delineation drilling phase, wellfield designs will be prepared which define the extraction or economic limits of the ore body. The wellfield design will include injection, recovery, monitor well locations and surface facilities (e.g. header houses, pipelines and power lines). The topsoil resource management during the wellfield installation and operation is further discussed in Section 3.1.9 of the Operations Plan.

Since ISL mining does not require the removal of topsoil and overburden for mining, calculation of topsoil volumes is not appropriate for all disturbed areas. Estimates of salvageable topsoil volumes required for the development of Mine Unit No.1, including facilities and roads is presented on Table OP 6-1 of the Operations Plan.

The topsoil removal will be directed by qualified personnel utilizing soils mapping and other data provided herein. The estimated suitability ranges for the dominant soil series within the Permit Area are found in Table 4. The percent of each series within the corresponding mapping units is found in Table 5.

TABLE 1
ACREAGES OF SOIL MAPPING UNITS

Soil Mapping Unit	Proposed Permit Area	Proposed Disturbed Area	
	ACRES	ACRES	%
116 Blackhall-Rock Outcrop Complex, Steep	2427	371	34.3
131 Coalmont-Milren-Cragosen Complex, Rolling	1605	129	11.9
136 Cragosen-Carmody-Blazon Complex, Hilly	245	57	5.2
137 Brownsto-Lupinto Complex, 6-40%*	492	93	8.6
142 Diamondville-Forelle Association, Rolling	266	0	
148 Forelle-Poposhia Association, 2-12%	73	47	4.3
157 Havre-Absher-Forelle Loams, 0-6%	0[1]	0	
158 Havre-Forelle-Glendive Complex, 0-3%	1168	240	23.8
174 Milren-Bosler-Rock River Sandy Loams, 1-12%	808	0	
186 Poposhia-Blazon-Carmody Complex, Hilly	216	0	
208 Sinkson-Almy-Thermopolis Association, Rolling	0[1]	0	
229(D) Disturbed Area	318	41	3.8
229(R) Reclaimed Area	837	94	8.7
256 Rock Outcrop-Ustic Torriorthents, shallow-Rubble Land Complex, 30-100%*	0[1]	0	
M Unnamed Torrifluvent	28	10	1.0
R Water Surface (Reservoir)	17	0	
TOTAL	**8500**	**1081**	

*Natrona County Mapping Unit

1 - Not included within Permit Area

TABLE 2a
1996 ANALYZED SOIL INFORMATION AT SAMPLE LOCATIONS FOR THE PRI GAS HILLS PROJECT.

Site	Depth (in.)	SAR	Coarse Frag.%	EC	pH	Sat. %	Texture	B	Se
C	54-66	1.9	2.26	0.54	8.5	32	SCL		0.01
E	36-48	6.2	11.3	0.6	8.8	28.5	SCL		0.04
I	24-36	5.8	3.34	0.75	8.7	37.2	L		0.01
K	36-44	5.4	3.45	2.17	8.4	47.2	CL		0.02
L	16-24	1.83	4.62	1.339	8.38	46.8	SCL		0.005
N	0-8	2.22	6.75	.649	8.63	40.2	SCL		0.042
O	0-18	0.33	31.3	.732	8.54	49.5	CL		0.019
	8-18	0.43	2.67	.563	8.53	42.9	L		0.028
	18-30	1.21	1.71	.457	8.50	39.4	L		0.017
R	0-6	0.14	24.6	.625	8.43	40.5	SCL		0.011
S	0-18	1.67	4.37	.569	8.50	56.0	CL		0.013
	18-27	6.72	3.10	.561	8.86	53.6	CL		0.015
	27-40	10.05	4.41	.242	8.53	66.3	CL		0.035
	40-52	10.25	2.30	5.312	8.27	50.8	CL		0.046
T	0-14	26.55	9.30	2.837	8.85	66.8	C		0.058
	14-26	33.93	5.27	10.601	8.38	68.2	C		0.190
U	0-6	0.84	14.5	.823	8.50	49.1	SCL		0.035
V	0-12	1.12	2.72	.535	8.62	57.1	CL		0.017
	12-22	3.81	7.79	.463	8.71	50.8	CL		0.023
	22-34	9.62	12.1	.769	8.53	37.2	CL		0.016
Y	0-18	9.57	5.23	.583	8.89	53.2	CL		0.009
BB	0-18	0.55	4.11	.521	8.45	30.3	SCL		0.010
	18-25	2.58	6.17	.450	8.20	34.3	SCL		0.005
	25-37	5.10	8.37	.595	8.72	32.3	SCL		0.003

TABLE 2b
1997 ANALYZED SOIL INFORMATION AT SAMPLE LOCATIONS FOR THE PRI GAS HILLS PROJECT.

Site	Depth (in.)	SAR	Coarse Frag.%	EC	pH	Sat. %	Texture	B	Se	Lime
110	15-33	0.32	N/A	0.653	7.71	49.6	SCL	0.02	<0.002	2.86
110	33-51	1.29	N/A	0.890	7.76	44.8	SCL	0.30	<0.002	3.00
119	6-18	0.28	N/A	0.454	7.78	41.0	SCL	0.40	0.002	22.6
131	0-12	0.40	N/A	0.804	7.87	54.5	SCL	0.40	0.033	1.72
131	12-24	0.51	N/A	0.755	7.88	52.1	L	0.40	0.015	2.33
132	0-12	0.34	N/A	0.318	7.88	54.6	SCL	0.40	0.010	0.14
137	36-48	5.87	N/A	0.460	8.33	38.4	SCL	0.50	<0.002	2.91
130	0-14	3.13	N/A	0.848	8.10	71.9	C	0.60	<0.002	7.19
130	14-28	2.72	N/A	0.523	8.26	62.4	CL	0.40	<0.002	5.67
101	0-12	N/A	N/A	N/A	N/A	N/A	SL	N/A	N/A	0.57
101	12-21	N/A	N/A	N/A	N/A	N/A	SL	N/A	N/A	1.76
101	21-36	N/A	N/A	N/A	N/A	N/A	L	N/A	N/A	3.14
102	0-3	N/A	N/A	N/A	N/A	N/A	SCL	N/A	N/A	0.48
102	3-13	N/A	N/A	N/A	N/A	N/A	SCL	N/A	N/A	0.38
103	0-3	N/A	N/A	N/A	N/A	N/A	CL	N/A	N/A	0.48
103	3-7	N/A	N/A	N/A	N/A	N/A	CL	N/A	N/A	0.53
103	7-18	N/A	N/A	N/A	N/A	N/A	SCL	N/A	N/A	0.48
104	0-3	N/A	N/A	N/A	N/A	N/A	CL	N/A	N/A	0.53
104	3-15	N/A	N/A	N/A	N/A	N/A	C	N/A	N/A	0.53
104	15-24	N/A	N/A	N/A	N/A	N/A	CL	N/A	N/A	0.86

LEGEND FOR TABLE 2a and 2b

Site	Soil Mapping Unit	Sampled Soil Series
C	136 Cragosen-Carmody-Blazon Complex, Hilly	Rock River (inclusion)
E	186 Poposhia-Blazon-Carmody Complex, Hilly	Cushool (inclusion)
I	158 Havre-Forelle-Glendive Complex, 0-3%	Forelle
K	158 Havre-Forelle-Glendive Complex, 0-3%	Forelle
L	116 Blackhall-Rock Outcrop Complex, Steep	Coalmont (inclusion)
N	131 Coalmont-Milren-Cragosen Complex, Rolling	Cragosen
O	131 Coalmont-Milren-Cragosen Complex, Rolling	Carmody (inclusion)
R	116 Blackhall-Rock Outcrop Complex, Steep	Cragosen (inclusion)
S	158 Havre-Forelle-Glendive Complex, 0-3%	Poposhia (inclusion)
T	186 Poposhia-Blazon-Carmody Complex, Hilly	Poposhia Sodic Phase (inclusion)
U	186 Poposhia-Blazon-Carmody Complex, Hilly	Blazon
V	158 Havre-Forelle-Glendive Complex, 0-3%	Havre
Y	116 Blackhall-Rock Outcrop Complex, Steep	Diamondville (inclusion)
BB	136 Cragosen-Carmody-Blazon Complex, Hilly	Carmody
101	158 Havre-Forelle-Glendive Complex, 0-3%	Havre
102	158 Havre-Forelle-Glendive Complex, 0-3%	Glendive
103	158 Havre-Forelle-Glendive Complex, 0-3%	Blazon
104	137 Brownsto-Lupinto, 6-40%	Coalmont
110	158 Havre-Forelle-Glendive Complex, 0-3%	Forelle
119	131 Coalmont-Milren-Cragosen Complex, Rolling	Cragosen
130	"M"	Unnamed Torrifluvent
131	"M"	Unnamed Torrifluvent
132	116 Blackhall-Rock Outcrop Complex, Steep	Blazon
137	116 Blackhall-Rock Outcrop Complex, Steep	Havre

TABLE 3
TAXONOMIC CLASSIFICATION OF THE PREDOMINANT SOIL SERIES WITHIN THE PERMIT AREA

Series Name	Taxonomic Classification
Blackhall	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent
Blazon	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent
Carmody	Coarse-loamy, mixed (calcareous), frigid, Ustic Torriorthent
Coalmont	Fine, montmorillonitic Borollic Paleargid
Cragosen	Loamy-skeletal, mixed (calcareous), frigid, shallow Ustic Torriorthent
Diamondville	Fine-loamy, mixed Borollic Haplargid
Forelle	Fine-loamy, mixed Borollic Haplargid
Glendive	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvent
Havre	Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvent
Milren	Fine, montmorillonitic Borollic Paleargid
Poposhia	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthent
Rock River	Fine-loamy, mixed Borollic Haplargid

TABLE 4
ESTIMATED SUITABILITY RANGES FOR THE DOMINANT SOIL SERIES WITHIN THE PERMIT AREA

Soil Series	Depth of Suitable Material (inches) Range	Median	Limiting Factors
Blazon	6-12	9	strong alkalinity, high pH
Carmody	18-24	21	strong alkalinity, high pH
Cragosen	0-6	3	cobbles/gravels near surface
Coalmont	12-18	15	alkalinity, high pH
Diamondville	12-18	15	alkalinity, high pH
Forelle	36-48	42	alkalinity, high pH
Glendive*	24-30	27	alluviated material
Havre	24-36	30	alkalinity, high pH
Milren*	24-36	30	alkalinity, high pH
Poposhia	18-24	21	sodium hazard
Poposhia Sodic Phase	0-6	3	sodium hazard
Rock River	42-60	51	alkalinity, high pH
Blackhall*	0-6	3	alkalinity, high pH
Brownsto**		9	alkalinity, high pH, cobbles/gravel
Lupinto**		9	alkalinity, high pH, gravel
Inclusions		20	

*Not included in laboratory analysis
** Maximum suitable depth from NRCS description

NOTES: 1. For minor inclusions an average suitable depth of 12 inches was assumed.
2. For map unit M, Unnamed Torrifluvent, a suitable depth of 24 inches was assumed.
3. For reclaimed lands, 229(R), an average suitable depth of 8 inches was assumed.

TABLE 5
PERCENT OF SOIL SERIES WITHIN EACH SOIL MAPPING UNIT

Soil Mapping Unit/Soil Series	Percent of Series	Suitable Depth (Feet)
116 Blackhall-Rock Outcrop Complex, Steep		0.3*
Blackhall loam, 25-45%	60	
Rock Outcrop	25	
Inclusions	15	
131 Coalmont-Milren-Cragosen Complex, Rolling		1.3
Coalmont loam, 2-20%	45	
Milren loam, 1-8%	20	
Cragosen gravelly loam, 5-30%	15	
Inclusions	20	
136 Cragosen-Carmody-Blazon Complex, Hilly		0.7
Cragosen gravelly loam, 6-40%	50	
Carmody gravelly sandy loam, 6-40%	20	
Blazon sandy clay loam, 6-40%	15	
Inclusions	15	
137 Brownsto-Lupinto Complex, 6-40%*		0.8
Brownsto cobbly loam, 15-40%	60	
Lupinto gravelly loam, 6-20%	25	
Inclusions	15	
142 Diamondville-Forelle Association, Rolling		Not Disturbed
Diamondville loam, 2-15%	50	
Forelle loam, 2-15%	30	
Inclusions	20	
148 Forelle-Poposhia Association, 2-12%		2.4
Forelle loam, 2-8%	45	
Poposhia loam, 2-12%	40	
Inclusions	15	
157 Havre-Absher-Forelle Loams, 0-6%		Not Disturbed
Havre loam, 0-3%	40	
Absher loam, 1-6%	20	
Forelle loam, 1-6%	20	
Inclusions	20	
158 Havre-Forelle-Glendive Complex, 0-3%		2.4
Havre loam, 0-3%	45	
Forelle loam, 1-3%	20	

Glendive sandy loam, 0-3%	15
Inclusions	20

TABLE 5
PERCENT OF SOIL SERIES WITHIN EACH SOIL MAPPING UNIT (CONT.)

Soil Mapping Unit/Soil Series	Percent of Series	Suitable Depth (Feet)
174 Milren-Bosler-Rock River Sandy Loams,1-12%		Not Disturbed
Milren sandy loam, 1-8%	45	
Bosler sandy loam, 1-8%	20	
Rock River sandy loam, 1-12%	15	
Inclusions	20	
186 Poposhia-Blazon-Carmody Complex, Hilly		Not Disturbed
Poposhia loam, 3-20%	35	
Blazon clay loam, 6-40%	30	
Carmody fine sandy loam, 3-25%	15	
Inclusions	20	
208 Sinkson-Almy-Thermopolis Association, Rolling		Not Disturbed
Sinkson loam, 2-15%	45	
Almy loam, 2-10%	20	
Thermopolis loam, 10-30%	20	
Inclusions	15	
229 Disturbed Area		0
229(R) Reclaimed Area		0.7
256 Rock Outcrop-Ustic Torriorthents-Rubble Land Complex, 30-100%*		Not Disturbed
Rock Outcrop, 30-100%	40	
Ustic Torriorthents, shallow, 30-100%	25	
Rubble Land	15	
Inclusions	20	
M Unnamed Torrifluvent		2.0

*Natrona County Mapping Unit

ADDENDUM D7-1
CORRESPONDENCE

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June 26, 1997

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RE: Topsoil Baseline, PRI Gas Hills ISL Project. TFN 3 5/93.

Dear Brenda,

I reviewed your June 9, 1997 letter concerning soils baseline information necessary at the PRI Gas Hill ISL project. I regret to say I am somewhat confused about the content of that letter. The following comments reflect what I expressed to you in reviews and over the phone:

1. I feel my October 28, 1997 letter to you (attached) and the Soils Completeness comments adequately outline what is necessary for a functional soils baseline study.

2. The major function of requiring the additional "affected area" soils data was to enable PRI to formulate the most accurate affected area topsoil balance as possible. This information is critical in the formulation of a functional reclamation plan. This concept should be the driving force behind your baseline soils data collection program.

3. Remapping of the soils is not necessary as long as your field efforts show that it wasn't grossly mis-mapped originally. I do not want you to delineate out each soils series contained within an association mapping unit. However, your field data collection can be used to fine-tune the NRCS' soils series percentages for that association or complex within the affected area. Again, the fine-tuning work you do is directed toward the most accurate topsoil stripping balance as possible for that mapping unit.

4. I believe you have some confusion over what you term the "10 acre limit." Soils, unlike vegetation communities, do not have a 10-acre break off where data are not necessary. I continue to believe a minimum of three soil depth determinations would be necessary to formulate an accurate topsoil salvage depth for a small (10 acres was my example), uniform soil depth map unit. If a small map unit (Map Unit "M", for example)

encompasses only 5 acres of affected land but exhibits a high degree of soil depth variability, some additional depth determinations or possible mapping boundary adjustments may be in order to arrive at an accurate estimate of the soil resource available. Also, if you take three soil depth measurements on a large mapping unit and those data are fairly uniform and correspond to the NRCS descriptions for soil depths, those three data points can be used to accurately formulate a soil balance for that map unit. Again, as stated in the vegetation comments, the field data will direct you to an acceptable sample size.

Hopefully, these comments will assist you in your baseline data collection. As you have probably heard, I will be transferring to the Water Quality Division in the immediate future. If you have any questions concerning this letter, please contact Mark at (307) 332-3047.

JS:js

attachment

Sincerely,

Jack Smith,.
Sr. Environmental Specialist

xc: Rick Chancellor
Paul Hildenbrand - PRI, 800 Werner Court, Suite 230, Casper, WY 82601
Mark Moxley

BKS ENVIRONMENTAL ASSOCIATES, INC.

P.O. Box 3467
Gillette, WY 82717-3467
(307) 682-3810
Fax (307) 682-0125

P.O. Box 6021
Laramie, WY 82070-6021
(307) 721-5179
Fax (307) 721-5179

FILE COPY

June 9, 1997

Mr. Jack Smith
WDEQ-LQD
250 Lincoln
Lander, WY 82520

Dear Jack:

Per our phone conversation today regarding the WDEQ Initial Completeness Review (dated February 21, 1997) for the PRI Gas Hills ISL Application, the purpose of this letter is to finalize proposed additional soil sampling needs for 1997 based on your discussion with BRS/PRI personnel. According to Table 1 in the December 1996 permit submittal, the majority of listed map units exceed 10 acres which is the acreage limit for requiring a minimum of three samples/map unit which is what you had requested. The legend for Table 2 in the permit submittal describes the soil series sampled for laboratory analysis; eight of thirteen were series inclusions within the larger map units, a problem that is often associated with such large scale Order 3 mapping. For your general information and review, attached is a table that summarizes the information from both of these from the permit application.

The major question pertaining to additional sampling needs regards the clarification of the 10 acre limit discussed with BRS/PRI. Based on our phone conversation today, the 10 acre limit refers to the map unit itself not the individual soil series within the map unit. In order to quantify the topsoil resource within the proposed disturbed area, two primary concerns must be addressed.

1) What is the percentage of the major soil series within the map unit, i.e., do the individual percentages reflect original NRCS estimates for Eastern Fremont County?

2) What is the variability of the major series within the map unit in regards to the typical profile location for that series described by the NRCS for Eastern Fremont County?

As you stated, your intention is not to have PRI remap their existing D7 map or rename series found within the disturbed area, if they should vary from the original NRCS series descriptions. Field observations to address the two issues above will be sufficient. Sampling for additional analysis should only be done if designated stripping depths in the permit vary substantially from that described in the original NRCS survey. Existing soils information gathered in the fall 1996 from the "permit area" and "outside the permit area" (known at that time) will be used to reinforce depth findings for the soil mapping within the proposed disturbed area.

Jack, I would appreciate any comments you may have as soon as possible since we are formulating summer fieldwork plans. Thank you for your input. If you have any questions, please feel free to contact me in Gillette at (307)682-3810.

Sincerely,

Brenda K Schladweiler

Brenda K. Schladweiler
BKS ENVIRONMENTAL ASSOCIATES, INC.

cc. Paul Hildebrand, PRI
Doug Beahm, BRS

THE STATE OF WYOMING

GERINGER
GOVERNOR

Department of Environmental Quality

250 Lincoln Street ● Lander, Wyoming 82520-2848 ● Fax (307) 332-7726

ABANDONED MINES	AIR QUALITY	LAND QUALITY	SOLID & HAZARDOUS WASTE	WATER QUALITY
(307) 332-5085	(307) 332-6755	(307) 332-3047	(307) 332-6924	(307) 332-3144

October 28, 1996

Ms. Brenda Schladweiler
BKS Environmental Associates, Inc.
P.O. Box 6021
Laramie, WY 82070-6021

RE: Soils Work Plan, Power Resources Gas Hills Project.

Dear Brenda,

This letter is in response to your September 16, 1996 letter outlining a "Soils Work Plan" for the PRI project. The items listed below correspond to your proposed baseline soils data collection methods.

Item 1. Remapping the soils onto a 1"=500' photographic base with delineations of the permit boundary and all proposed affected lands is acceptable.

Item 2. Field verification to adjust and refine the soil delineation boundaries and to formulate a topsoil balance is necessary. I agree that the exact number will vary and PRI should concentrate on those areas to be affected. Soil stripping depth data need to be collected on each of the series and/or associations. The exact number will depend upon how accurately the soil mapper can delineate series boundaries from aerial photographs and the accuracy of existing RCS data.

A proposal for a uniform, partial soil stripping program within the monitoring ring remains open pending LQD review of the specifics of such a plan. Native soils within this monitoring ring will still need field verification for proper baseline series/association delineation and to refine unit boundaries. Additionally, field verification of soil depths from within the monitoring ring is necessary in the formulation of the specific, uniform stripping plan. For example, verification of soil depths will determine if a 6 inch, 10 inch, or 4 inch uniform stripping depth proposal is most appropriate.

Item 3. Lands proposed as "no strip" by the operator due to unsuitable physical or chemical characteristics will require some specific physical and/or chemical analysis data to demonstrate their unsuitability. For example, if PRI reports that 10 acres of bottomland soils will not be salvaged for reclamation due to unsuitable levels of sodium, the application will have to provide

specific EC and SAR data collected on-site to demonstrate such unsuitability.

Item 4. Existing RCS soil survey data can be used to describe the general physical and chemical nature of specific soil series/associations found within the permit and proposed affected area. I do suggest that caution be taken here. In most cases, RCS series descriptions are for the "type location" with outlier units of the same series having formed under slightly different physical conditions. Field verification is necessary to correlate the existing soils to their "type" description.

Hopefully my views will aid you in formulating the baseline soils section for the PRI project. If you have any questions or comments concerning the items in this letter, please give me a call at (307) 332-3047.

Sincerely,

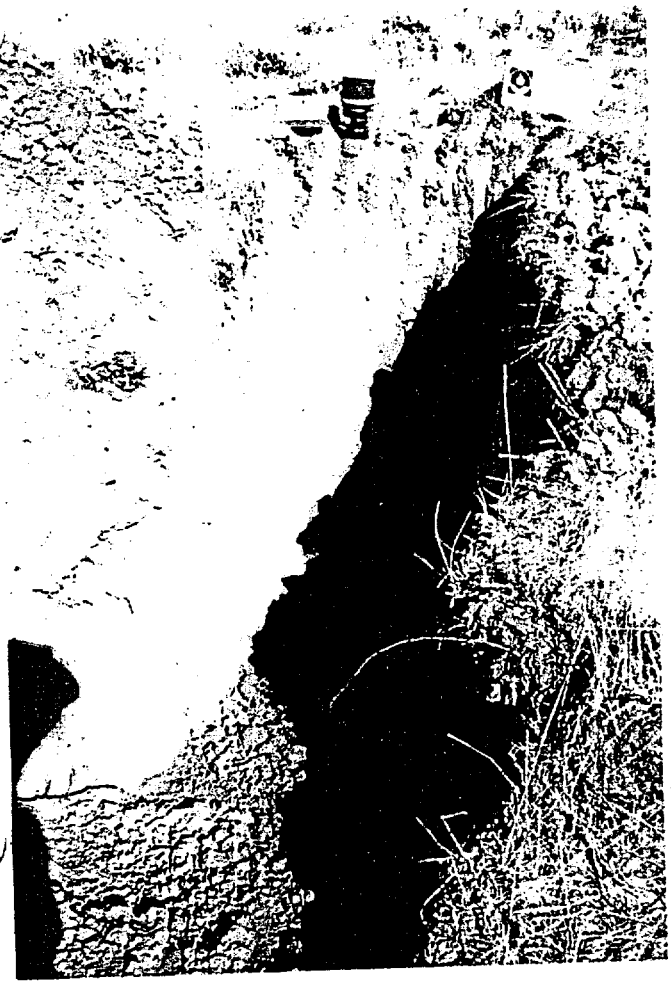
Jack Smith

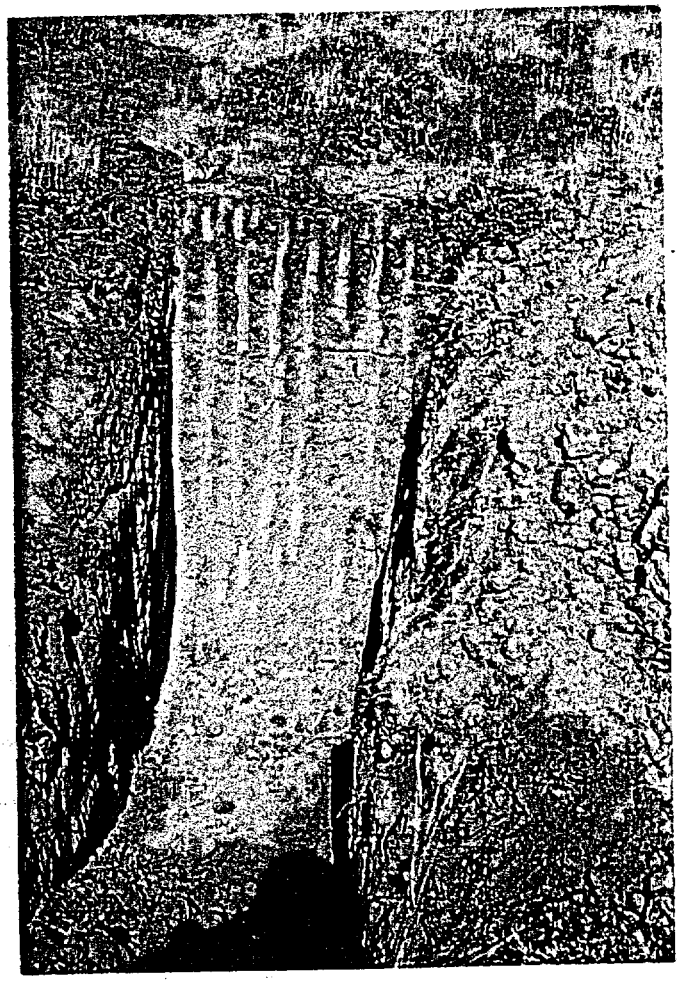
Jack Smith
Sr. Environmental Specialist

JS:js

xc: Mark Moxley
Rick Chancellor

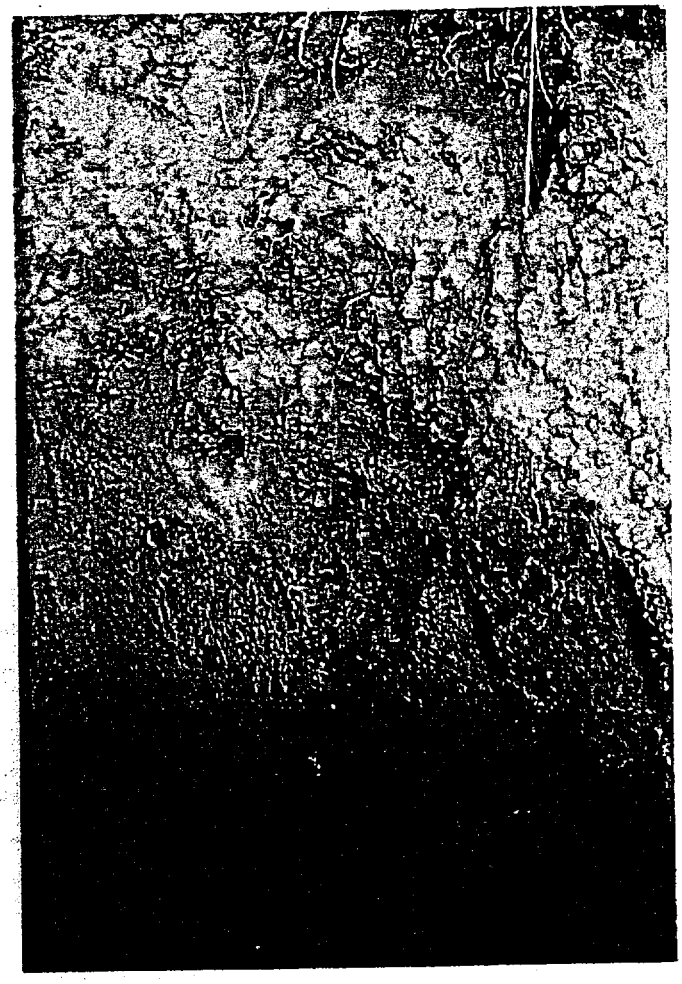
ADDENDUM D7-2
FIELD NOTES/SOIL SAMPLE POINT PHOTOGRAPHS





Left Hand Photo. Sample Point C, Rock River Series (inclusion) within Map Unit 136 Cragosen-Carmody-Blazon Complex, Hilly.

Right Hand Photo. Sample Point E, Cushool Series (inclusion) within Map Unit 186 Poposhia-Blazon-Carmody Complex, Hilly.

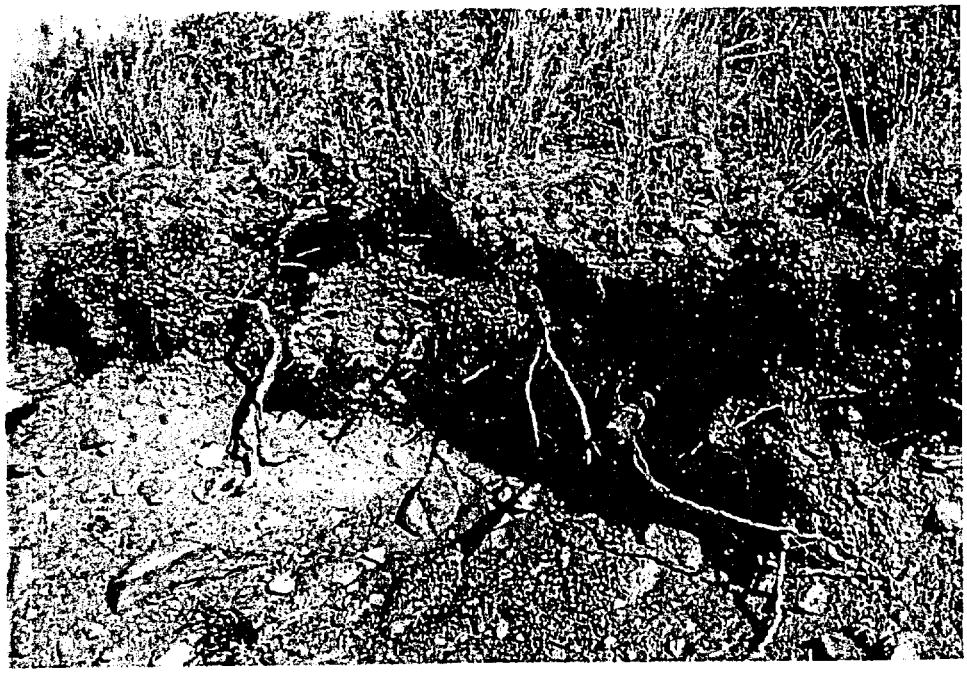


Left Hand Photo. Sample Point I, Forelle Series within Map Unit 158 Havre-Forelle-Glendive Complex, 0-3%.

Right Hand Photo. Sample Point K, Forelle Series within Map Unit 158 Havre-Forelle-Glendive Complex, 0-3%.

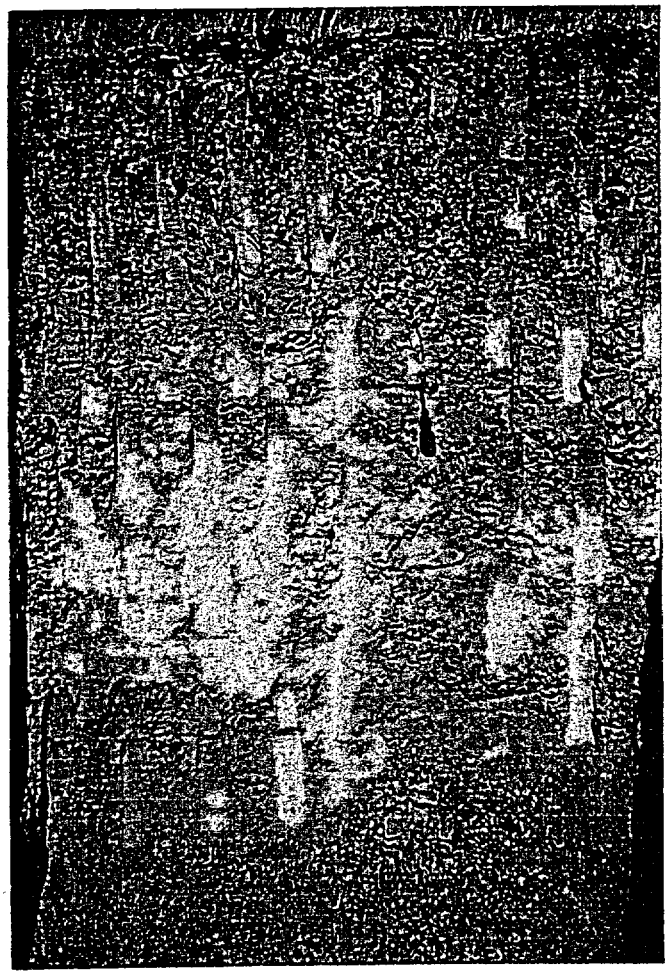
Left Hand Photo. Sample Point L, Coalmont Series (inclusion) within Map Unit 116 Blackhall-Rock Outcrop Complex, Steep.

Right Hand Photo. Sample Point N, Cragosen Series within Map Unit 131 Coalmont-Milren-Cragosen Complex, Rolling.

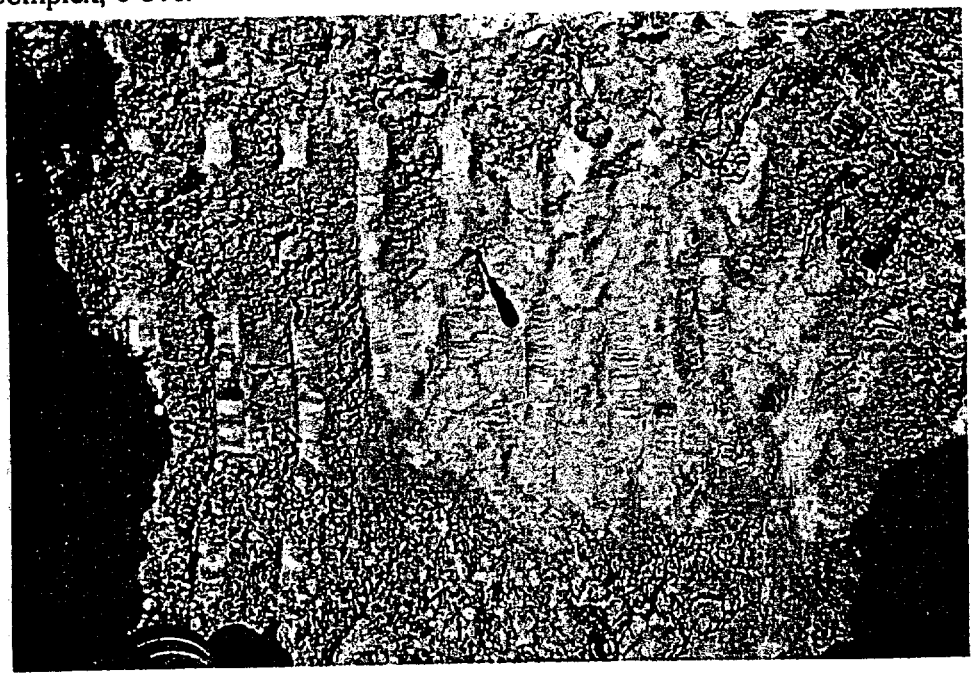


Top Photo. Sample Point O, Carmody Series (inclusion) within Map Unit 131 Coalmont-Milren-Cragosen Complex, Rolling.

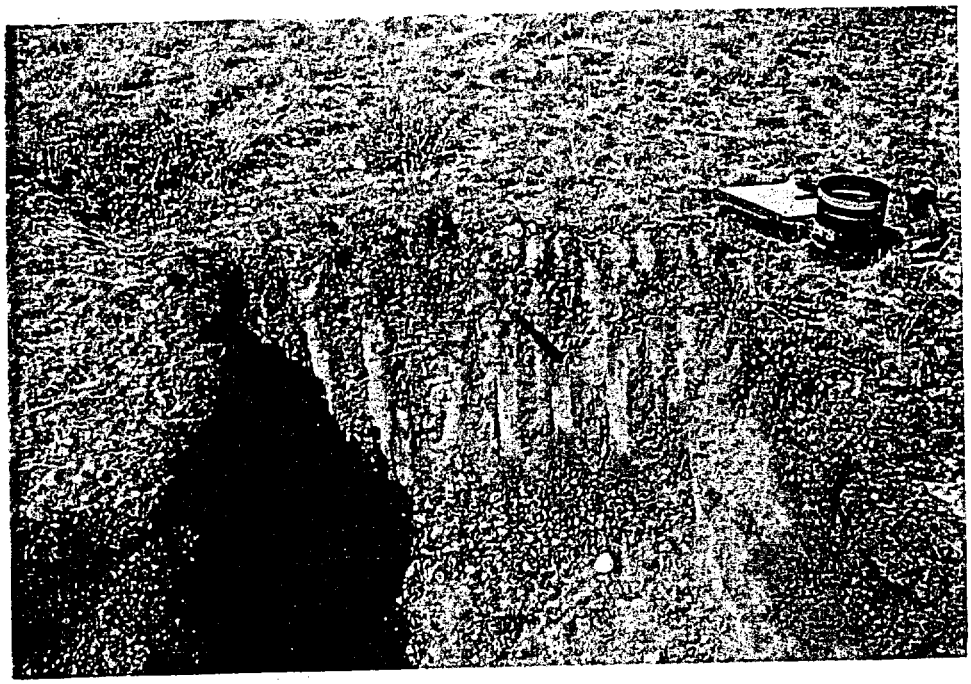
Bottom Photo. Sample Point R, Cragosen Series (inclusion) within Map Unit 116 Blackhall-Rock Outcrop Complex, Steep.



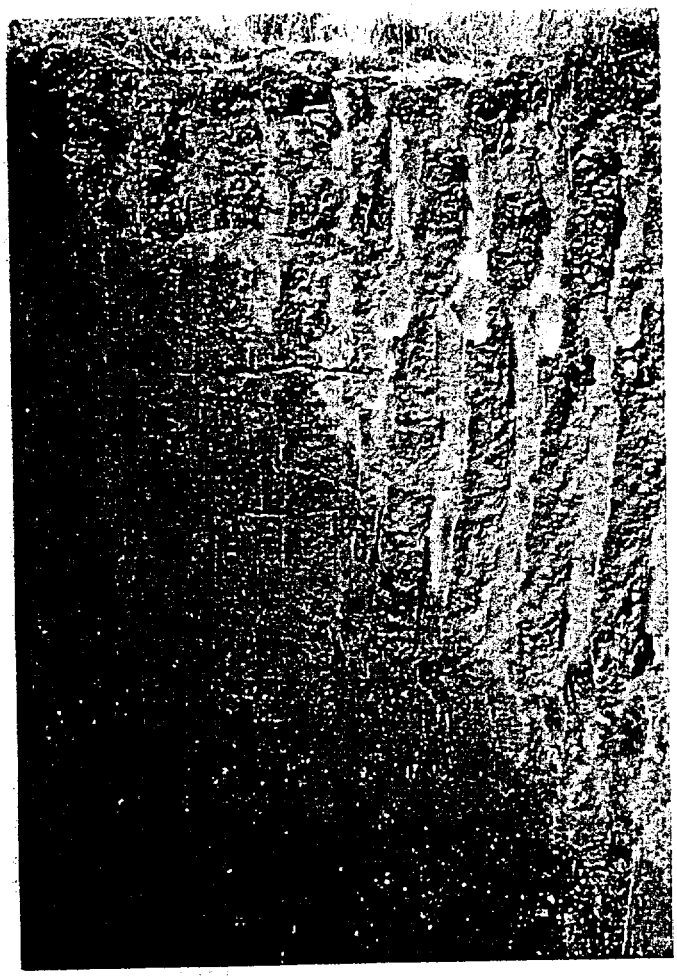
Top Photo. Sample Point S, Poposhia Series (inclusion) within Map Unit 158 Havre-Forelle-Glendive Complex, 0-3%.



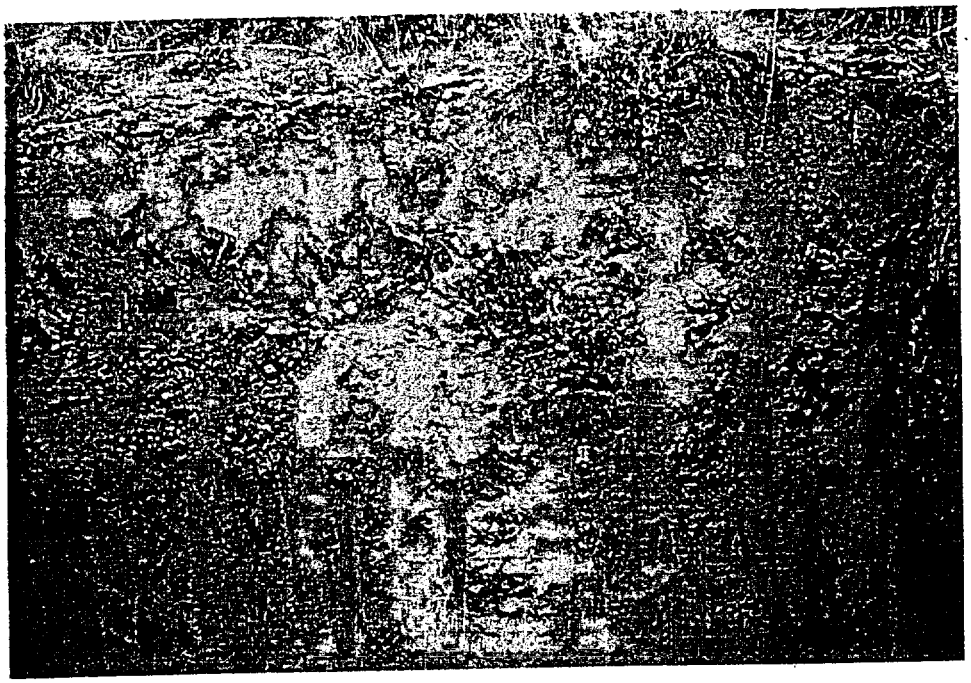
Bottom Photo. Sample Point T, Poposhia Sodic Phase (inclusion) within Map Unit 186 Poposhia-Blazon-Carmody Complex, Hilly.



Top Photo. Sample Point U, Blazon Series within Map Unit 186 Poposhia-Blazon-Carmody Complex, Hilly.



Bottom Photo. Sample Point V, Havre within Map Unit 158 Havre-Forelle-Glendive Complex, 0-3%.



Top Photo. Sample Point Y, Diamondville Series (inclusion) within Map Unit 116 Blackhall-Rock Outcrop Complex, Steep.

Bottom Photo. Sample Point BB, Carmody Series within Map Unit 136 Cragosen-Carmody-Blazon Complex, Hilly.

disk: BKS Inventories
file: soilveri.dta

SOIL MAPPING VERIFICATION
(OVERVIEW SURVEY)

Project: PRI GAS HILLS
Date: 9-5-96
Sampler: BKS

Hole #	Position	~~Series~~ MAP UNIT	Horizon Depth	Horizon Text	Horizon $CaCO_3$	Aug. Depth	Comments
1	TOESLOPE	136					186 & 158 X VALLEY OK
2	RIDGETOP	136					
3	TOP OF HILL	136					NEAR EXPLORATION PIT
4	MEADOW	M					N. RIPRAPPED DRAINAGE
5	MEADOW	M					ABOVE DAM
6	SLOPE	136					COBBLEY
7	SLOPE	136					
8	RECLAIMED RIDGE						
9	SLOPE	116					
10	RIDGETOP	136					EXPLOR. PIT - TS 12"
11	FLAT UPL	131					
12	MEADOW	M					
13	MEADOW	M					CAMERON SPRINGS
14	DISTURBED	229					
15	FLAT UPL	131					
16	FLAT UPL	131					
17	FLAT UPL	131					
18	UPL DRG	158					
19	SLOPE	186					
20	TERRACE	158					BY DAM
21	UPLAND	131					

TOPSOIL SURVEY FIELD LOG

FORELLE SERIES

Sample # A

Date 9-23-96

Soil Type DIAMONDVILLE-FORELLE MAP UNIT 142

Stripping Depth 54"

Reason LARGE COBBLES

Depth	Texture
0 - 6"	CL (EST.)
6 - 12"	
12 - 18"	
18 - 24"	
24 - 30"	SL (EST)
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	SL @ BOTTOM
54 - 60"	

Comments

SIDE SLOPE TO DRAINAGE
NEAR UMETCO DIST.
OLD ROAD TO W.

HEAVY COBBLES @ 54"
MOD. EFFERVESCENT @ BOTTOM
PHOTO 1 (36 ROLL)

Initial BKS

DIAMONDVILLE (?)

Sample # B

Date 9-23-96

Soil Type MAP UNIT 142

Stripping Depth 18"

Reason Small pea size gravel, lime

Depth	Texture
0 - 6"	L
6 - 12"	SCl
12 - 18"	S or Sl
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

NEAR OLD SURVEY CABLE
ON GENTLE SLOPE
NEAR GAS PIPELINE
MOD. EFFERV. 12-18"
Photo 2 (36 roll)
red brown color 6-12"
DEFINITE Bt

Initial BKS

ROCK RIVER SERIES

Sample # C

Date 9-23-96

Soil Type CRAGSDEN-CARMODY-BURZON MAP UNIT 136

Stripping Depth 54"

Reason SANDY TEXT., CALC. THREADS

SHOULD BE 142 Border w/136

Depth	Texture	
0 - 6"	L	A
6 - 12	SCl	Bt
12 - 18"	SCl	
18 - 24"	CL	Btk
24 - 30"	mildly calc	
30 - 36"		
36 - 42"		
42 - 48"	SL	C
48 - 54"		
54 - 60"6	SL	

Comments

TOE SLOPE
NEAR GAS PIPELINE
MOD. TO STRONG EFFERV
54-66"

DEEP DIAMONDVILLE → ROCK RIVER ✓
DEFINITE Bt
Photo 3

Initial BKS

SAMPLED 54-66"

DEPTHS VARY SIGNIFICANTLY
-STRIP DOWN GRID

TOPSOIL SURVEY FIELD LOG

OR CUSHOOK

CRAGOSEN SERIES

Sample # D

Date 23 SEPT 96

Soil Type MAP UNIT 136

Stripping Depth 6"

Reason COBBLES @ OR NEAR SURFACE

Depth	Texture
0 - 6"	SCL
6 - 12"	
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

WEAKLY CALC 0-6
MOD CALC 6+
Photo 4
FOOTSLOPE POSITION

MIXED SS 6+
Photo 5 - E FACING

Initial BKS

DID NOT SAMPLE

CARMODY (?)

Sample # E

Date 23 SEPT 96

Soil Type POPOSHIA-BURZON-CARMODY MAP UNIT 186

Stripping Depth 22" (maybe 36")

Reason COARSE SAND

Depth	Texture
0 - ~~6~~ 3"	L
6 - 12"	SCL
12 - 18"	↓
18 - 24"	SL
24 - 30"	↓
30 - 36"	↓
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

SAMPLED 36-48"
Photo 6 - short distance between shallow/mod deep

A 0-3
Bt 3-15 (OR Bw)
Btk 15-22
Ck1 22-36
Ck2 36+

Initial BKS

Photo 7
MILDLY CALC 15-36"
STRONG/MOD CALC 36+
RESIDUUM/ALLUVIATED SS 36+
SLIGHT DRAINAGE

HAVRE SERIES

Sample # F

Date 23 SEPT 96

Soil Type HAVRE-FORELLE-GLENDIVE MAP UNIT 158

Stripping Depth 21"

Reason ALLUVIATE SAND

Depth	Texture
0 - 6"	L
6 - 12 heavy	CL
12 - 18"	↓
18 - 24"	SL (coarse)
24 - 30"	↓
30 - 36"	↓
36 - 42"	FineSL
42 - 48"	
48 - 54"	
54 - 60"	

Comments

COLORS INDICATIVE OF C
Photo 8 - base of slope
N. OF SMALL DRAINAGE (FLAT GROUND)
NOTICEABLE COLOR Δ @ ≈12"

A 0-4
Bw 4-21
C1 21-37
C2 37+

Initial BKS

Photo 9
SAMPLED 21-37"

MOD. CALC 37+
21-37" lenses [illegible]

TOPSOIL SURVEY FIELD LOG

mod. deep Glendive	Carmody Series	Glendive Series = Forelle
Sample # G	Sample # H	Sample # I
Date 23 Sept 96	Date 23 Sept 96	Date 23 Sept 96
Soil Type Havre-Forelle-Glendive Map Unit 158	Soil Type Map Unit 158	Soil Type Map Unit 158
Stripping Depth 22"	Stripping Depth 19"	Stripping Depth 36"
Reason Large Cobbles	Reason Residual/Alluviated Sand	Reason Residual/Alluviated Sand/Silt

Depth	Texture	Depth	Texture	Depth	Texture
0 - 6"	L	0 - 6"	SiL	0 - 6"	L
6 - 12"	CL	6 - 12"	↓	6 - 12	CL
12 - 18"	SL	12 - 18"	↓	12 - 18"	↓
18 - 24"	↓	18 - 24"		18 - 24"	↓
24 - 30"		24 - 30"		24 - 30"	SiCL
30 - 36"		30 - 36"		30 - 36"	↓
36 - 42"		36 - 42"		36 - 42"	
42 - 48"		42 - 48"		42 - 48"	
48 - 54"		48 - 54"		48 - 54"	
54 - 60"		54 - 60"		54 - 60"	

Comments

0-3 A
3-12 Bw
12-22 C1
22+ C2 large cobbles
Photo 10
mod. calc 22+
Initial BKS
In Between Drainages
mod deep soil
Not Sampled

Comments

Photo 11
mod calc throughout
0-3" sod, A
3-19" C1
19"+ C2
Flat Area By TS Pile
Sampled 3-19"
Initial BKS
mod calc - quest quality (typical Carmody)

Comments

Photo 12
strong calc @ 36"
0-5 A
5-19 Bt
19-24 Btk
24-36 C1
36+ C2
Flat Outwash Area
Initial BKS
Sampled 24-36"
Large Bt horizon (columnar)

TOPSOIL SURVEY FIELD LOG

CARMODY SERIES

Sample # J

Date 23 SEPT 1996

Soil Type CRAGOSEN-CARMODY-BUCON MAP UNIT 136

Stripping Depth 24"

Reason RESIDUAL SANDSTONE

Depth	Texture
0 - 6"	L
6 - 12"	SL
12 - 18"	↓
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

Photo 13

MIDSLOPE ON NE FACING HILL

A 0-3 L
Bw 3-16 SL
C1 16-24 ↓
C2 24+

Initial BKS

SAMPLED 16-24"
STRONGLY CALC 24+
MOD CALC 16-24"

Forelle Series

Sample # K

Date 23 SEPT 1996

Soil Type HAVRE-FORELLE-GLENDIVE MAPUNIT 158

Stripping Depth 36"

Reason ALLUVIATED SILT AND LIME

Depth	Texture
0 - 6"	CL
6 - 12"	SCL
12 - 18"	↓
18 - 24"	
24 - 30"	CL
30 - 36"	↓
36 - 42"	SiCl
42 - ~~48~~ 44"	↓
48 - 54"	
54 - 60"	

Comments

UPPER END OF MAPUNIT
DEFINITE Bt

0-8 A
8-24 Bt
24-36 Btk
36-44 C1
44+ C2

Initial BKS

SAMPLED 36-44"
STRONGLY CALC 44+
MOD CALC 36-44
Photo 14-15

Blackhall

Sample # L

Date 23 SEPT 96

Soil Type 116

Stripping Depth 24"

Reason

Depth	Texture
0 - 6"	L
6 - 12	heavy CL
12 - 18"	↓
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

SE OF VEG EXCLOSURE
COBBLES @ SURFACE & SCATT. THROUGHOUT
Photo 16
MILDLY CALC 16-24"
A 0-4
Bw 4-16
C1 16-24"
MILREN-LIKE OR COALMONT

Initial BKS

Mod Deep Blackhall
Sampled 16-24

Photo 17 also

COALMONT

OR CRAGOSEN!

TOPSOIL SURVEY FIELD LOG

BLACKHALL?

Sample # M

Date 24 SEPT 96

Soil Type MAPUNIT 116

Stripping Depth 0"

Reason WEATH SHALE & SILTSTONE & LIME

Depth	Texture
0 - ~~6~~ 4"	SiL
6 - 12"	
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

Photo 17 - long view of cut

SAMPLED 0-4" (STRIP DEPTH?)

Photo 18 PROFILE

mod to strong cFF. thruout

Small rock Frags at Surface

O.M. near plants only

Initial BKS

0-2

C 2+

CRAGOSEN SERIES

Sample # N

Date 24 SEPT 96

Soil Type MAPUNIT 131

Stripping Depth 8"

Reason COBBLES

Depth	Texture
0 - ~~6~~ 8"	CL
6 - 12"	
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

NEAR BASE OF MULLGTOW

Photo 19 - PROFILE

strongly calc 8+

SAMPLED 0-8"

SCATT ROCK FRAGS @ SURFACE

A 0-2

C1 2+8

PARALITHIC 8+ (LARGE AMT COBBLES)

Initial BKS

CARMODY?

Sample # O

Date 24 SEPT 96

Soil Type MAP UNIT 131

Stripping Depth 24"

Reason WEATH SS/SILTSTONE & LIME

Depth	Texture
0 - ~~6~~ 3"	SiL
~~6 - 12~~ 3-8	↓
8 ~~12~~ - 18"	SiCL
18 - 24"	↓
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

FLAT AREA W. OF DRAINAGE

Photo 20 - PROFILE

Sm. ROCK FRAGS SCATT. @ SURFACE

0-3 A
3-8 BW
8-18 C1
18-30 C2

SAMPLED 0-8 8-18 18-30 SAVE FOR ANALYSIS

30+ C30R PARALITHIC

Initial BKS

mod to strong calc 8-30

viol. calc 30+

TOPSOIL SURVEY FIELD LOG

CRAGOSEN SERIES

Sample # P

Date 24 SEPT 96

Soil Type MAP UNIT 131

Stripping Depth 12"

Reason COBBLES

Depth	Texture
0 - 6"	SL (COARSE)
6 - 12"	
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

ON FLAT AREA W. OF RD.
Photo 21 - PROFILE
A/C 0-6"

DARKER COLOR THROUGHOUT (REDDISH)

DID NOT SAMPLE

Initial BKS

CARMODY ?

Sample # Q

Date 24 SEPT 96

Soil Type MAP UNIT 158

Stripping Depth 24"

Reason COBBLES

Depth	Texture
0 - ~~6~~" 3	L
~~6 - 12"~~ 3-14	CL
~~12 - 18"~~ 14-25	SiL (except sand lense)
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

SIMILAR TO K & O
Photo 22 - PROFILE
SAND LENSE 14-17"
A 0-3
Bt 3-14 (Bw?)
C1 14-25
C2 25+

Initial BKS

CRAGOSEN SERIES

Sample # R

Date 24 SEPT 96

Soil Type MAP UNIT 116

Stripping Depth 0"

Reason ~~wt~~ COARSE SS AND LIME

Depth	Texture
0 - 6"	COARSE SL
6 - 12	
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments

Photo 23 - PROFILE BLANK
SAMPLED 0-6"
A/C 0-6"
STRONG CALC >6"

Initial BKS.

SAMPLED 14-25"
MOD. DEEP FORELLE ?
MOD. CALC. 10-25
STRONG CALC. 25+

TOPSOIL SURVEY FIELD LOG

POPOSHIA SERIES	POPOSHIA SERIES (?) SODIC PHASE	BUZON SERIES
Sample # S	Sample # T	Sample # U
Date 24 SEPT 96	Date 24 SEPT 96	Date 24 SEPT 96
Soil Type MAP UNIT 158	Soil Type MAP UNIT 186?	Soil Type MAP UNIT 186
Stripping Depth 27"	Stripping Depth 14" ?	Stripping Depth 0"
Reason ALLUVIATED WEATH SILTSTONE & LIME	Reason SODIUM	Reason SS LAYERS W/ MIXED CLAY

Depth	Texture	Depth	Texture	Depth	Texture
0 - ~~6~~" 2	CL	0 - 2 ~~6~~"	heavy CL	0 - 6"	SCL
~~6 - 12"~~ 2-18	↓	6 - ~~12~~" 14	C	6 - 12	
~~12 - 18"~~ 18-27	SiCL	~~12 - 18~~" 14+	C	12 - 18"	
~~18 - 24"~~ 27-40	CL	18 - 24"		18 - 24"	
~~24 - 30"~~ 40+	SiCL	24 - 30"		24 - 30"	
30 - 36"		30 - 36"	Sampled	30 - 36"	
36 - 42"		36 - 42"	0-14"	36 - 42"	
42 - 48"		42 - 48"	14-26"	42 - 48"	
48 - 54"		48 - 54"		48 - 54"	
54 - 60"		54 - 60"		54 - 60"	

Comments

UPPER END MAP UNIT - GRASSY WIDE DRAINAGE
Photo 24
STRONGLY CALC THROUGHOUT
A 0-2
Bw 2-18
C1 18-27
C2 27-40
C3 40+
Initial BKS
SAMPLED 0-18 18-27 27-40 40-52"

Comments

IN SMALL SADDLE BETWEEN DEFINITE 116 AND 186
ARTPED VERY COMMON
Photo 25 PROFILE & 26 BROAD VIEW
mod calc throughout
quest salt threads common >14"
high clay throughout
A 0-2 C2 14+
C1 2-14 (sodium)
Initial BKS

Comments

S. FACING GENTLE SLOPE
Photo 27 PROFILE & 28 (WALLED)
Sm. ROCK FRAGS @ SURF.
POCKETS OF CLAY
mod to strong calc >6"
SAMPLED 0-6"
Initial BKS

TOPSOIL SURVEY FIELD LOG

HAVRE SERIES?	GLENDIVE SERIES?	GLENDIVE SERIES
Sample # V	Sample # W	Sample # X
Date 24 SEPT 96	Date 24 SEPT 96	Date 24 SEPT 96
Soil Type MAP UNIT 158	Soil Type MAP UNIT 158	Soil Type MAP UNIT 158
Stripping Depth 34"	Stripping Depth 22" POSSIBLE 37"	Stripping Depth 23"
Reason ROCK FRAGS & LIME	Reason ALLUVIATED WEATH SILTSTONE & SS	Reason ALLUVIATED SAND

Depth	Texture	Depth	Texture	Depth	Texture
0 - ~~6~~"2	CL	0 - ~~6~~"2	L	0 - ~~6~~"4	L
~~6 - 12~~"2-8	↓	2~~6~~ - 12"	CL	~~6 - 12~~ 4-23	CL
~~12 - 18~~"8-12	↓	12 - ~~18~~"22	SiL	~~12 - 18~~" 23-34	COARSE SL
~~18 - 24~~" 12-22	heavy CL	~~18 - 24~~"22-37	↓	18 - 24" 34-45	FINE SL
~~24 - 30~~"22-34	↓	~~24 - 30~~"37-51	↓	24 - 30"	
30 - 36"	↓	~~30 - 36~~" 51+	SAND	30 - 36"	
36 - 42"		36 - 42"		36 - 42"	
42 - 48"		42 - 48"		42 - 48"	
48 - 54"		48 - 54"		48 - 54"	
54 - 60"		54 - 60"		54 - 60"	

Comments

A 0-2
BW 2-8
Bk 8-12
CK1 12-22
CK2 22-34
ROCK FRAGS @ 34"
GREEN QUARTZ COLOR >48"
Photo 29.
Initial BKS

Comments

Photo 30
FLAT AREA ADJACENT TO DRAINAGE, N. MAIN RD
A 0-2
BW 2-12
C1 12-22
C2 22-37
C3 37-51
C4 51+ SAND
Initial BKS

Comments

PHOTO 31
0-4
4-23
23-34 COARSE SAND
34-45 FINE SAND
45+ ALLUV. ROCK FRAGS W/ QUART SALTS
mod to strong calc throughout
Initial BKS

SAMPLED 0-12
12-22
22-34
heavy text. throughout.

SAMPLED 22-37"
UNIFORM COLOR

DID NOT SAMPLE

Yallow Diamondville ✓ Blazon? Soil Series?

TOPSOIL SURVEY FIELD LOG

Y

Sample # Y

Date 24 Sept 96

Soil Type MAP UNIT 116

Stripping Depth 18"

Reason WEATH. GREEN SHALE

Depth	Texture
0 - ~~6~~" 7	CL
7~~6~~ - ~~12~~" 18	heavy CL TOC
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments
Photo 32
IN SMALL SADDLE AT HEAD OF WIDE DRAINAGE
A 0-7 L
C 7-18 heavy CL
Cr 18+ heavy CL
noncalc to 18"
strongly calc > 18

Initial BKS

SAMPLED 0-18"

Very Blocky C STRUCTURE TO 18" (RED BROWN COLOR)
2.5Y COLORS AT DEPTH (GREEN) - SIMILAR TO T&U

Z

Sample # Z

Date 24 Sept 96

Soil Type MAP UNIT 116

Stripping Depth 12"

Reason WEATH GREEN mixed SS/Shale w/COBBLES

Depth	Texture
0 - ~~6~~" 2	CL
2~~6~~ - 12"	heavy CL
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments
Photo 33
SIMILAR TO Y EXCEPT LIMESTONE COBBLES @ DEPTH
FLAT RIDGE
RED BROWN THROUGHOUT TO LAYER
A 0-2
C 2-12"
STRONG CALC >12"

Initial BKS

DID NOT SAMPLE

STRONG BLOCKY C

AA

Blazon series

Sample # AA

Date 24 Sept 96

Soil Type MAP UNIT 131

Stripping Depth 12"

Reason COARSE WEATHSS

Depth	Texture
0 - ~~6~~" 3	L
3~~6~~ - 12	↓ (Some sand)
12 - 18"	
18 - 24"	
24 - 30"	
30 - 36"	
36 - 42"	
42 - 48"	
48 - 54"	
54 - 60"	

Comments
BORDERLINE 158 & 131
SIMILAR TO Z (LESS CLAY)
A 0-3
C 3-12"

non-calc 0-12"
mod calc >12"

NOT SAMPLED

Initial BKS

Photo 34

TOPSOIL SURVEY FIELD LOG

CARMODY

Sample # BB	Sample #	Sample #
Date 24 SEPT 96	Date	Date
Soil Type CENGOSEN-CARMODY-BUZON MAPUNIT 136	Soil Type	Soil Type
Stripping Depth 25"	Stripping Depth	Stripping Depth
Reason WEATH SS & SLIME	Reason	Reason

Depth	Texture	Depth	Texture	Depth	Texture
0 - ~~6"~~ 4	SCL	0 - 6"		0 - 6"	
4 ~~6~~ - ~~12"~~ 18	↓	6 - 12"		6 - 12	
~~12 - 18"~~ 18-25	SL	12 - 18"		12 - 18"	
~~18 - 24"~~ 25-37	↓	18 - 24"		18 - 24"	
~~24 - 30"~~ 37+	FINE SAND	24 - 30"		24 - 30"	
30 - 36"		30 - 36"		30 - 36"	
36 - 42"		36 - 42"		36 - 42"	
42 - 48"		42 - 48"		42 - 48"	
48 - 54"		48 - 54"		48 - 54"	
54 - 60"		54 - 60"		54 - 60"	

Comments

E FACING GENTLE SLOPE ABOVE RECA
Poa spp. Common w/ ARTEMISIA BIGWEEK(?)

Photo 35 & 36 & 37

MOD CALC 25-37

Initial BKS

SAMPLED 0-18
18-25
25-37

Comments

Initial _____

Comments

Initial _____

SOIL SURVEY FIELD LOG

HAVRE (upper terrace)

Sample # 101

Date 9-3-97

Soil Type 158 HAVRE-FORELLE-GLENDIVE COMPLEX

~~Stripping Depth~~ (HAVRE)

Reason

Depth	Texture
~~0-12~~ 3 A	SL
3-12 ~~12-24~~ BW	
12-21 ~~24-36~~ Ck1	
21-36+ ~~36-48~~ Ck2	
60	
60+	

COMMENTS

SERIES SAMPLED IN 96 AS F & V (F NEVER SENT FOR ANALYSIS)

NON-CALC 0-12

SAMPLED 0-12
12-21 *
21-36 *

LOCATED NEAR RECLAIMED GATE & SURVEY MARKER (marked on map within #4) WITHIN MSG

GLENDIVE (near stream)

Sample # 102

Date 9-3-97

Soil Type 158

Stripping Depth (GLENDIVE)

Reason

Depth	Texture
3 ~~0-12~~	A
3-13+ ~~12-24~~	C
24-36	
36-48	
48-60	
60+	

COMMENTS

W. OF RD, N OF DRAINAGE WITHIN BS

SAMPLED IN 96 AS W (@ 37") BUT NEVER ANALYZED

NON-CALC 0-13

SAMPLED 0-3
3-13 *

BUZON (POSSIBLE AUMONT IF MOD. DEEP)

Sample # 103

Date 9-3-97

Soil Type 158

Stripping Depth (BUZON)

Reason

Depth	Texture
~~0-12~~ 3	A L
3-7 ~~12-24~~ BW	SCL
7-9 ~~24-36~~ C1	CL
9-18+ ~~36-48~~ C2	SiCL
48-60	
60+	

COMMENTS

NEAR FENCE AND BASE OF RIM HILLS WITHIN MSG

SAMPLED IN 96 AS L (16-24")

MILDLY CALC 7-18+

SAMPLED 0-3
3-7
7-19 *

Sabrina w/Pel

SOIL SURVEY FIELD LOG

COAUMONT SERIES	TORRIFLUVENT	TORRIFLUVENT
Sample # 104	Sample # 105	Sample # 107
Date 9-3-97	Date 9-3-97	Date 9-3-97
Soil Type 137 BROWNSTO-LUPINTO (NATRONA COUNTY MAP UNIT)	Soil Type M	Soil Type M
Stripping Depth (COAUMONT)	Stripping Depth 26"	Stripping Depth >36"
Reason	Reason ALLUV. SAND	Reason ALLUV. MATERIAL (ESTIMATED)

Depth	Texture	Depth	Texture	Depth	Texture
~~0-12~~ 0-3	A L	~~0-12~~ 0-6	A SiL	0-12	NO TEXT OR HORIZ.
~~12-24~~ 3-12	Bt (weak) CL	~~12-24~~ 6-26	Cl SiL (some structure)	12-24	
~~24-36~~ 12-15	Bk CL	~~24-36~~ 26+	(? COARSE SAND	24-36	
~~36-48~~ 15-24+	C SiCL	36-48		36-48	
60		48-60		48-60	
60+		60+		60+	

COMMENTS

N. OF H_2O WELL SITE
WITHIN MSG MAPUNIT
NOT SAMPLED IN 96
MILDLY CALC. 12-24"
COAUMONT SAMPLED IN 96 (16-24")
SAMPLED 0-3
3-15
15-24+

COMMENTS

IN MAJOR DRAINAGE BELOW 104
CALC 6-26
DID NOT SAMPLE
RIPARIAN VEG BELOW CUT BANK

COMMENTS

NEAR WILLOW PATCH
DID NOT SAMPLE

SOIL SURVEY FIELD LOG

CHAUMONT

Sample # 108

Date 9-3-97

Soil Type 137

Stripping Depth 20"

Reason CALC. SILTY

Depth	Texture
0-12	NO TEXT OR HORIZ
12-24	↓
24-36	
36-48	
48-60	
60+	

COMMENTS

IN OLD DOZER PIT
DID NOT SAMPLE

HAVRE

Sample # 109

Date 9-3-97

Soil Type 137

Stripping Depth 24"

Reason CALC EROSIVE SILTY MATERIAL

Depth	Texture
0-12	NO TEXT. OR HORIZ
12-24	↓
24-36	
36-48	
48-60	
60+	

COMMENTS

ERODED CHANNEL
DID NOT SAMPLE

Forelle

Sample # 110

Date 9-3-9

Soil Type 158

Stripping Depth 15" FOR GOOD TO 40" FOR MARGINAL

Reason

Depth	Texture	
0-~~12~~ 4	A	L
4-15 ~~12-24~~	Bt	L
15-40+ ~~24-36~~	C	SiL
36-48		
48-60		
60+		

COMMENTS

ABOVE DAM BY CAROL SHOP
WITHIN BS/W TRANSITION
SAMPLED AS K IN 96 (36-44")
SAMPLED 15-33 33-51
CALC 15-51"
MATER IN 15-51+ → IS LIKELY EROSIVE

SOIL SURVEY FIELD LOG

FORELLE
Sample # 111
Date 9-3-97
Soil Type 158
Stripping Depth >24"
Reason ONLY HAD SPADE WITH

Depth	Texture
0-~~12~~ 4	A
4-24+ ~~12-24~~	Bt
24-36	
36-48	
60	
60+	

COMMENTS

NON-CALC THROUGHOUT
BY CAROL SHOP
WITHIN MSG
SEE #110

NOT SAMPLED

Sample # 112
Date 9-3-97
Soil Type 116
Stripping Depth 0"
Reason COBBLES @ SURF

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

DID NOT AUGER OR SAMPLE
BY CAROL SHOP
WITHIN MSG

COALMONT
Sample # 113
Date 9-4-97
Soil Type 131 COALMONT-MILLEN-CRAGGEN
Stripping Depth 28"
Reason COARSE SAND MORE COMMON

Depth		Texture
0-~~12~~ 3	A	light CL
3-9 ~~12-24~~	Bt	" "
9-15 ~~24-36~~	Btk	CL
15-28+ ~~36-48~~	C	SCL
48-60		
60+		

COMMENTS

CALC 9-28+
DID NOT SAMPLE
STAKE LOCATED NEARBY SAID SEC 31, DRILL HOLE 6020-5070 T.D. 600'

(303) 799-9828 TRAVIS LOUSE

SOIL SURVEY FIELD LOG

DAUMONT

Sample # 114

Date 9-4-97

Soil Type 131

Stripping Depth 24"

Reason SANDY MATERIAL

Depth	Texture
0-~~12~~ 4	CL
4-15 ~~12-24~~	CL
15-24 ~~24-36~~	heavy CL
24-32 ~~36-48~~	SCL
0	
60+	

COMMENTS

LOCATED IN OLD DOZER PIT
CALC 15-24+
Bt QUITE EVIDENT

CRAGOSEN

Sample # 115

Date 9-4-97

Soil Type 131

Stripping Depth 8"

Reason 8-18" MARGINAL MATERIAL

Depth	Texture
0-~~12~~ 2	A L
2-8 ~~12-24~~	Bw L
8-18 ~~24-36~~	C SCL
36-48	
48-60	
60+	

COMMENTS

CALC 8-18"
COBBLES @ 18
LOCATED IN OLD DOZER PIT

Sample # 116

Date 9-4-97

Soil Type 131

Stripping Depth 0"

Reason ROCK OUTCROP @ SURF

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

12" @ 1620-5270 (CRAGOSEN)

COMMENTS

LOCATED AT HEAD OF FORKED DRAINAGE

STAKE @ BACKHOE PIT READS 1420-5270 T.D. 540' SEC 31

10" @ 1380-0100 SEC 32 (BASE OF ROCK - SCL)
18-24" DOWNSLOPE @ 1580-0200 & 1680-0100

CONTINUE

SOIL SURVEY FIELD LOG

SALMONT
Sample # 117
Date 9-4-97
Soil Type 131
Stripping Depth 17"
Reason

Depth		Texture
0-~~12~~ 2	A	L
2-17 ~~12-24~~	Bt	CL
17-27 ~~24-36~~	C	SiCL
36-48		
48		
60+		

COMMENTS

CALC 17-27"
COBBLES >27"
LOCATED IN OLD DOZER PIT
DID NOT SAMPLE.

Sample # 118
Date 9-4-97
Soil Type 131
Stripping Depth VARIOUS
Reason

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

VARIOUS HOLES
- 6-12" TS IN SHALLOW
- 12-24" TS IN MOD. DEEP (SLIGHT POCKETS)

WIDE VARIABILITY
COBBLY @ VARYING DEPTHS

CRAGOSEN
Sample # 119
Date 9-4-97
Soil Type 131
Stripping Depth (CRAGOSEN) 5"
Reason SANDY

Depth	Texture
0-~~12~~ 5	L
5-18 ~~12-24~~	SL
24-36	
36-48	
48-60	
60+	

COMMENTS

CALC. 5-18"
DID NOT SAMPLE
SAMPLED 6-18" (SOME ORANGE POCKETS @ DEPTH)
≈6-12" TS IN CLUSTER OF 3 PITS

SOIL SURVEY FIELD LOG

Sample # 120
Date 9-4-97
Soil Type CRAGOSEN
Stripping Depth 5"
Reason COBBLY

Depth	Texture
0-~~12~~ 5	L
~~12-24~~ 5-12	SiL
24-36	
36-48	
0	
60+	

COMMENTS

@ DRILL STAKE 2120-4020 T.D. 480' SEC 31

NEAR ROAD - S. SIDE

CALC. 5-12"

ACROSS ROAD IN DEEPER SOIL, MAY HAVE 2-3' TS

Sample # 121
Date 9-4-97
Soil Type VARIOUS
Stripping Depth 6-12"
Reason COBBLY

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

PINK EXCAVATED MATERIAL AT TOP OF HILL

NEAR ROAD - N. SIDE

18-24" ON LEEWARD SIDE OF HILL

Sample # 122
Date 9-4-97
Soil Type CRAGOSEN
Stripping Depth 8"
Reason SILTY MATERIAL

Depth	Texture
0-~~12~~ 2	L
2-8 ~~12-24~~	lightCL
8-16 ~~24-36~~	SiCL
36-48	
48-60	
60+	

COMMENTS

LOCATED IN OLD DOZER PIT

CALC 8-16"

SOIL SURVEY FIELD LOG

Sample # 123	CRAGOSEN Sample # 124	MILLREN Sample # 125
Date 9-4-97	Date 9-4-97	Date 9-4-97
Soil Type Rock outcrop	Soil Type 131	Soil Type 131
Stripping Depth 0"	Stripping Depth CRAGOSEN	Stripping Depth 33+
Reason	Reason	Reason

Depth	Texture	Depth	Texture	Depth	Texture
0-12		0-~~12~~ 4	SL	0-~~12~~ 4	A L
12-24		4-8 ~~12-24~~	COARSE SL	4-15 ~~12-24~~	Bt light CL
24-36		24-36		15-33+ ~~24-36~~	C SiCL
36-48		36-48		36-48	
48-60		48-60		48-60	
60+		60+		60+	

COMMENTS

DID NOT SAMPLE.

COMMENTS

DID NOT SAMPLE
CALC 4-8"
WITHIN CLUSTER OF 4 PITS (5 VARIED 8-12" IN DEPTH

COMMENTS

CALC 15-33+
LOCATED IN OLD DOZER PIT
AT BASE OF DOZER (5-5.5') SIMILAR TO 33"
(MAY BE ALLUVIATED FROM SIDES)

SOIL SURVEY FIELD LOG

RAGESON

Sample # 126

Date 9-4-97

Soil Type 116

Stripping Depth 15"

Reason

Depth	Texture	
0-~~12~~2	A	SCL
2-6 ~~12-24~~	Bt	↓
6-15+ ~~24-36~~	C	
36-48		
0		
60+		

COMMENTS

CALC 6-15"
IN OLD DOZER BIT ON SIDE OF MSGOR RB HILLS

MARG TS 6-15.

EXCAVATED MATERIAL EXTREMELY CLAYEY & SODIC (SOME $CaCO_3$)

MILREN? POSS. HAVRE

Sample # 127

Date 9-4-97

Soil Type 131

Stripping Depth 28"+

Reason

Depth	Texture	
0-~~12~~6	A	L
6-28+ ~~12-24~~	C	CL
24-36		
36-48		
48-60		
60+		

COMMENTS

WEAKLY DEVELOPED "NEW" BACKHOE PIT
BLOCK STRUCTURE IN C
CALC 6-28+

IN CLUSTER OF 6
6-12" ON HILLTOPS (CLAY)
18-24" IN DRAINAGES (HAVRE)

Sample # 128

Date 9-4-97

Soil Type 131/116 BORDEC

Stripping Depth 13"

Reason COBBLY

Depth	Texture
0-~~12~~2	L
2-13 ~~12-24~~	L
24-36	
36-48	
48-60	
60+	

COMMENTS

CALC 2-13"
WITHIN RD CUT

SOIL SURVEY FIELD LOG

PAGE 5 OF N

Sample # 129
Date 9-4-97
Soil Type 131
Stripping Depth 7"
Reason COBBLY

Depth	Texture
0-~~12~~ 7	L
12-24	
24-36	
36-48	
0	
60+	

COMMENTS

LOCATED IN OLD DOZER PIT
CALC 0-7 (?)

Sample # 130
Date 9-4-97
Soil Type M
Stripping Depth 28"
Reason SAND LENSES

Depth	Texture
0-~~12~~ 25	CL
~~12-24~~ 25-28	SCL
24-36	
36-48	
48-60	
60+	

COMMENTS

CALC THROUGHOUT
DRAINAGE BY RD
LUPANG COMMON
MAY BE DEEPER MATERIAL IF SAND LENSES THIN
SAMPLED 0-14
14-28

Sample # 131
Date 9-4-97
Soil Type M
Stripping Depth 24"
Reason SANDY MAT.

Depth	Texture
0-12	FINE SL
12-24	↓
24-36	
36-48	
48-60	
60+	

COMMENTS

CALC THROUGHOUT
W. CANYON CRK CROSSING
SAMPLED 0-12, 12-24

SOIL SURVEY FIELD LOG

BUZON

Sample # 132

Date 9-5-97

Soil Type 116

Stripping Depth 12"

Reason WEATH.

Depth	Texture
0-~~12~~ 3	A SiL or FineSL
~~12-24~~ 3-12	C SiCL
24-36	
36-48	
0	
60+	

COMMENTS

WEAKLY CALC TO NON-CALC THROUGHOUT

NEAR WET AREA (BLOCKED EARLIER THIS SUMMER)

SAMPLED 0-12" 0-3 more suitable

CRAGESON

Sample # 133

Date 9-5-97

Soil Type 116

Stripping Depth 0"

Reason

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

BLADE CUT

CRAGESON

Sample # 134

Date 9-5-97

Soil Type 116

Stripping Depth 0"

Reason

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

CALC @ SURF NEAR SURVEY CONTROL POINT

PHOTOS ROLL 3 1-3

SOIL SURVEY FIELD LOG

CRAGESON

Sample # 135

Date 9-5-97

Soil Type 116

Stripping Depth 0"

Reason COBBLY

Depth	Texture
0-~~12~~ 4	L TO SL
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

NON CALC THROUGHOUT

STEEP, ROCKY SLOPES

CRAGESON

Sample # 136

Date 9-5-97

Soil Type 116

Stripping Depth 0"

Reason COBBLY

Depth	Texture
0-12	
12-24	
24-36	
36-48	
48-60	
60+	

COMMENTS

NON-CALC THROUGHOUT

STEEP, ROCKY SLOPES

DRAINAGES HAVE SANDY CHANNELS

BENTONITE OUTCROPS COMMON

HAUFE?

Sample # 137

Date 9-5-97

Soil Type 116

Stripping Depth 36"+

Reason SANDY MATERIAL

Depth	Texture
0-~~12~~ 36	C L
36-48 ~~12-24~~	C SCL
24-36	
36-48	
48-60	
60+	

COMMENTS

NEAR DRAINAGE

SM POCKET OF SUITABLE MATERIAL IN ROAD CUT

SAMPLED 36-48"

SOIL SURVEY FIELD LOG

Sample # 138	Sample # 139	Sample # 140
Date 9-5-97	Date 9-5-97	Date 9-5-97
Soil Type TORRIFLUVENT ?	Soil Type TORRIFLUVENT ?	Soil Type BLACKHALL
Stripping Depth 24"	Stripping Depth 24"	Stripping Depth 6"
Reason	Reason ALLUV. SANDY MATERIAL	Reason

Depth	Texture	Depth	Texture	Depth	Texture
0-12		0-12	SIL TO SICL	0-~~12~~ 6	SL
12-24		12-24		12-24	
24-36		24-36		24-36	
36-48		36-48		36-48	
48-60		48-60		48-60	
60+		60+		60+	

COMMENTS

ERODED CHANNEL BY. RD
24" TO COBBLES

COMMENTS

ERODED CHANNEL
24" TO SAND

COMMENTS

ROAD CUT TO W FROM WELL RD
RED-BROWN COLOR

20 TOTAL SAMPLES

SOIL SURVEY FIELD LOG

JAGESON Sample # 141	FORELLE Sample # 142	Sample #
Date 9-5-97	Date 9-5-97	Date
Soil Type 116	Soil Type 158	Soil Type
Stripping Depth 0"	Stripping Depth 18"	Stripping Depth
Reason COBBLY	Reason SANDY MATERIAL	Reason

Depth	Texture	Depth	Texture	Depth	Texture
0-12		0-~~12~~ 4	L	0-12	
12-24		~~12-24~~ 4-15	SL	12-24	
24-36		~~24-36~~ 15-36+	S(cobbles)	24-36	
36-48		36-48		36-48	
0		48-60		48-60	
60+		60+		60+	

COMMENTS

WITHIN MSGOR RB. TRANS.
CALC @ SURF

COMMENTS

IN BACKHOE PIT
0340-4850
T.D. 310'
(21-33-89)
STAKE MARKED
COARSE SAND @ 15"
IN AREA (3 PITS)
TS VARIES 12-18"

COMMENTS

ADDENDUM D7-3
LABORATORY ANALYSES

ENERGY LABORATORIES, INC.
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PHONE (307) 235-0515 • FAX (307) 234-1639

SOIL ANALYSIS REPORT

Client: BKS ENVIRONMENTAL, INC.
Report Date: October 25, 1996 Revised December 4, 1996

Lab I.D. #	Sample I.D.	pH sat. paste	Elec., Cond. mmho/cm	Sat., %	Ca meq/L	Mg meq/L	Na meq/L	SAR	Lime CaCO3 %	As ABDTPA ext., µg/g	B CaCl2 ext., µg/g	Se ABDTPA ext., µg/g	Sand, %	Silt, %	Clay, %	Texture
96: 54321	C 54 - 68	8.48	0.538	32.0	2.7	1.1	1.8	1.32	1.52	0.188	0.23	0.013	55	25	20	SCL
96: 54322	E 36 - 48	8.85	0.604	28.5	1.5	0.6	4.4	4.36	2.02	0.161	0.25	0.035	56	21	23	SCL
96: 54323	I 24 - 36	8.73	0.746	37.2	2.4	0.6	5.0	4.08	2.52	0.309	0.28	0.011	46	25	29	L
96: 54324	K 36 - 44	8.40	2.174	47.2	10.1	2.1	9.3	3.80	3.42	0.160	0.47	0.020	39	29	32	CL
96: 54325	L 16 - 24	8.36	1.339	46.8	9.7	1.7	3.1	1.29	0.57	0.031	0.10	0.005	56	27	17	SCL
96: 54326	N 0 - 8	8.63	0.649	40.2	6.1	1.7	3.1	1.57	0.97	0.042	0.10	0.042	52	29	19	SCL
96: 54327	O 0 - 8	8.54	0.732	49.5	7.1	1.2	0.5	0.23	4.67	0.051	0.17	0.019	35	30	35	CL
96: 54328	O 8 - 18	8.53	0.563	42.9	4.5	0.9	0.5	0.30	11.42	0.047	0.14	0.028	40	24	36	L
96: 54329	O 18 - 30	8.50	0.457	39.4	2.8	0.7	1.1	0.86	9.77	0.039	0.14	0.017	44	19	37	L
96: 54330	R 0 - 6	8.43	0.625	40.5	6.3	0.9	0.2	0.10	2.37	0.105	0.19	0.011	54	28	18	SCL
96: 54331	S 0 - 18	8.50	0.569	56.0	4.2	0.4	1.8	1.18	10.97	0.073	0.28	0.013	23	38	39	CL
96: 54332	S 18 - 27	8.66	0.561	53.6	1.2	0.3	4.1	4.75	10.17	0.053	0.35	0.015	24	37	39	CL
96: 54333	S 27 - 40	8.53	0.242	66.3	10.2	0.7	16.5	7.11	6.77	0.336	1.82	0.035	24	37	39	CL
96: 54334	S 40 - 52	8.27	5.312	50.8	36.4	1.8	31.7	7.25	9.62	0.121	2.52	0.046	27	30	43	CL
96: 54335	T 0 - 14	8.85	2.637	66.8	3.1	0.3	24.4	16.77	7.17	0.242	3.84	0.058	23	45	32	C
96: 54336	T 14 - 26	8.38	10.60	68.2	33.5	1.4	100.2	23.99	6.17	0.163	4.67	0.190	22	46	32	C
96: 54337	U 0 - 6	8.50	0.623	49.1	6.6	1.5	1.2	0.58	2.07	0.173	0.37	0.035	50	29	21	SCL
96: 54338	V 0 - 12	8.62	0.535	57.1	4.1	1.1	1.3	0.79	2.82	0.077	0.44	0.017	26	36	38	CL
96: 54339	V 12 - 22	8.71	0.463	50.8	1.9	0.5	3.0	2.69	8.92	0.024	0.49	0.023	29	36	35	CL
96: 54340	V 22 - 34	8.53	0.769	37.2	1.5	0.5	6.8	6.81	6.37	0.020	0.57	0.016	44	29	27	CL
96: 54341	Y 0 - 18	8.69	0.583	53.2	0.9	0.3	5.2	6.77	1.17	0.021	0.24	0.009	39	40	21	CL
96: 54342	BB 0 - 18	8.45	0.521	30.3	4.5	1.3	0.7	0.39	0.52	0.046	0.19	0.010	61	20	19	SCL
96: 54343	BB 18 - 25	8.20	0.450	34.3	1.9	0.7	2.0	1.83	* ISV	< 0.002	* ISV	0.005	64	22	14	SCL
96: 54344	BB 25 - 37	8.72	0.585	32.3	1.8	0.6	4.0	3.61	2.82	0.022	0.25	0.003	60	21	19	SCL

* Insufficient Sample Volume

Report Approved By:

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Reviewed By:

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICES

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SOIL ANALYSIS REPORT

Client: Power Resources, Inc. (BKS, Environmental)
Report Date: September 29, 1997

Lab I.D. #	Sample I.D.	pH, S.U.	Elec Cond mmho/cm	Sat., %	Ca, meq/l	Mg, meq/l	Na, meq/l	SAR	Lime as CaCO3, %	Neut. Pot., tons CaCO3/ 1000 tons	As ABDTPA ext., µg/g	Boron, CaCl2 ext., µg/g	Se, ABDTPA ext., µg/g	Sand, %	Silt, %	Clay, %	Texture	Very Fine Sand %
97- 53171	110 15-33"	7.71	0.653	49.6	5.80	1.12	0.60	0.32	2.86	28.6	0.057	0.02	< 0.002	48.0	24.8	27.2	SCL	15.0
97- 53172	110 33-51"	7.76	0.890	44.8	6.05	1.19	2.45	1.29	3.00	30.0	0.068	0.30	< 0.002	46.0	27.8	26.2	SCL	<1.00
97- 53173	119 6-18"	7.78	0.454	41.0	3.42	1.07	0.41	0.28	22.6	226	0.139	0.40	0.002	60.0	6.80	33.2	SCL	25.5
97- 53174	131 0-12"	7.87	0.804	54.5	7.30	0.99	0.81	0.40	1.72	17.2	0.357	0.40	0.033	52.0	24.8	23.2	SCL	17.5
97- 53175	131 12-24"	7.88	0.755	52.1	6.15	0.85	0.96	0.51	2.33	23.3	0.165	0.40	0.015	47.0	29.8	23.2	L	12.6
97- 53176	132 0-12"	7.88	0.318	54.6	2.57	0.43	0.42	0.34	0.14	1.44	0.044	0.40	0.010	49.0	24.8	26.2	SCL	18.1
97- 53177	137 36-48"	8.33	0.460	38.4	0.83	0.27	4.35	5.87	2.91	29.1	0.040	0.50	< 0.002	58.0	21.8	20.2	SCL	10.6
97- 53178	130 0-14"	8.10	0.848	71.9	4.41	0.52	4.91	3.13	7.19	71.9	0.100	0.60	< 0.002	39.0	17.8	43.2	C	36.2
97- 53179	130 14-28"	8.26	0.523	62.4	2.30	0.39	3.16	2.72	5.67	56.7	0.098	0.40	< 0.002	36.0	27.8	36.2	CL	18.06

Quality Assurance:

Control Soil Analysis	7.97	3.30	66.4	18.55	11.83	13.0	3.34	1.38	13.8	0.141	0.50	0.144	37.0	27.8	35.2	CL	13.7
Target Range	7.82-8.39	2.54-3.53	54.0-76.0	14.0-19.0	8.25-11.3	9.43-13.6	2.82-3.62	N/A	N/A	N/A	0.1-1.2	N/A	34.0-42.0	20.0-31.0	34.0-39.0	N/A	N/A

Report Approved by:
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Reviewed By: [illegible]

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SOIL ANALYSIS REPORT

Client: Power Resources, Inc. (BKS, Environmental)
Report Date: September 29, 1997

Lab I.D. #	Sample I.D.	Lime as CaCO3, %	Neut. Pot., tons CaCO3/ 1000 tons	Sand, %	Silt, %	Clay, %	Texture	Very Fine Sand %
97- 53160	101 0-12	0.57	5.73	71.0	11.8	17.2	SL	9.60
97- 53161	101 12-21	1.76	17.6	56.0	28.8	15.2	SL	<1.00
97- 53162	101 21-36	3.14	31.4	46.0	42.8	11.2	L	1.60
97- 53163	102 0-3	0.48	4.78	50.0	21.8	28.2	SCL	12.4
97- 53164	102 3-13	0.38	3.83	63.0	11.8	25.2	SCL	8.00
97- 53165	103 0-3	0.48	4.78	41.0	25.8	33.2	CL	9.62
97- 53166	103 3-7	0.53	5.25	45.0	16.8	38.2	CL	12.2
97- 53167	103 7-18	0.48	4.78	56.0	12.8	31.2	SCL	12.0
97- 53168	104 0-3	0.53	5.25	39.0	23.8	37.2	CL	14.8
97- 53169	104 3-15	0.53	5.25	36.0	21.8	42.2	C	15.6
97- 53170	104 15-24	0.86	8.59	39.0	22.8	38.2	CL	13.4

Quality Assurance:

Control Soil Analysis	1.38	13.8	37.0	27.8	35.2	CL	13.7
Target Range	N/A	N/A	34.0-42.0	20.0-31.0	34.0-39.0	N/A	N/A

Report Approved by:

Reviewed By: RCG

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ADDENDUM D7-4
SCS MAP UNIT DESCRIPTIONS FOR SOILS MAP UNITS IDENTIFIED ON THE STUDY AREA AND ADJACENT AREAS

APPENDIX D7-4

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116=Blackhall-Rock outcrop complex, steep.$T1 This map unit is on hills, ridges, and knobs. Slope is 25 to 45 percent. Areas are irregular in shape and are 10 to 300 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 6,300 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 60 percent Blackhall loam, 25 to 45 percent slopes, and 25 percent Rock outcrop. The Blackhall soil is on hills, ridges, and knobs and Rock outcrop is on escarpments. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Cragosen gravelly loam, 5 to 45 percent slopes; Coalmont loam, 5 to 20 percent slopes; and Milren loam, 1 to 8 percent slopes. Also included is Blackhall sandy loam on slopes of 45 to 99 percent. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Blackhall soil is very shallow or shallow and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is very pale brown loam 2 inches thick. The subsoil is very pale brown sandy loam 9 inches thick. Soft sandstone is at a depth of 11 inches.

Permeability of the Blackhall soil is moderate. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is moderate.

Rock outcrop is exposures of soft sandstone and siltstone.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Blackhall soil is mainly 15 to 25 percent bluebunch wheatgrass, 5 to 15 percent Indian ricegrass, 5 to 15 percent needleandthread, and 5 to 10 percent big sagebrush. As the range condition deteriorates, Sandberg bluegrass, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production varies from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

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The production of vegetation suitable for livestock grazing is limited by low precipitation, rooting depth, droughtiness, and short growing season. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Slope limits access by livestock and results in overgrazing of the less sloping areas.

$IO1The Blackhall soil is in capability subclass VIIe, dryland; and Rock outcrop is in capability class VIII, dryland. The Blackhall soil is in the Shallow Sandy, 10 to 14-inch ppt., High Plains Southeast range site. Rock outcrop has no range site assigned.

131=Coalmont-Milren-Cragosen complex, rolling.$T1 This map unit is on hills, fan aprons, and terraces. Slopes are 1 to 30 percent. Areas are irregular in shape and are 40 to 300 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 6,300 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 40 percent Coalmont loam, 2 to 20 percent slopes; 25 percent Milren loam, 1 to 8 percent slopes; and 15 percent Cragosen gravelly loam, 5 to 30 percent slopes. The Coalmont soil is on ridges and hillslopes, the Milren soil is on fan aprons, and the Cragosen soil is on terrace escarpments and hillslopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bosler fine sandy loam, 1 to 8 percent slopes, and Forelle loam, 1 to 20 percent slopes, in areas of Milren; and Cushool sandy loam, 5 to 25 percent slopes, in areas of Coalmont. Also included is a soil similar to Milren that does not have the abrupt textural change, in areas of Milren. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Coalmont soil is moderately deep and well drained. It formed in residuum and slope alluvium derived dominantly from shale interbedded with sandstone. Typically, the surface layer is grayish brown loam 2 inches thick. The upper 14 inches of the subsoil is olive clay. The lower 7 inches is olive clay loam. The substratum is olive clay loam 7 inches thick. Soft shale is at a depth of 30 inches.

Permeability of the Coalmont soil is slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion by water is severe. The hazard of erosion by wind is moderate.

The Milren soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown loam 3 inches thick. The upper 15 inches of the subsoil is yellowish brown sandy clay. The next 5 inches is yellowish brown clay. The lower part to a depth of 30 inches is pale brown loam. The substratum to a depth of 60 inches or more is very pale brown loam.

Permeability of the Milren soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion

by water is slight. The hazard of erosion by wind is moderate.

The Cragosen soil is shallow and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone and conglomerate. Typically, 30 percent of the surface is covered with gravel and cobbles. The surface layer is pale brown gravelly loam 2 inches thick. The subsoil is light yellowish brown very gravelly loam about 10 inches thick. Soft sandstone is at a depth of 12 inches.

Permeability of the Cragosen soil is moderate. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is slight.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Coalmont soil and the Milren soil is mainly 40 to 50 percent thickspike wheatgrass, 15 to 25 percent green needlegrass, 5 to 10 percent bluebunch wheatgrass, 5 to 10 percent bottlebrush squirreltail and 5 to 10 percent big sagebrush. As the range condition deteriorates, rhizomatous wheatgrasses, canby bluegrass, and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,000 pounds of air-dry vegetation per acre in normal years. Production varies from 1,300 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community on the Cragosen soil is mainly 15 to 25 percent bluebunch wheatgrass, 15 to 25 percent western wheatgrass, 5 to 10 percent mutton bluegrass, and 5 to 10 percent big sagebrush. As the range condition deteriorates, threadleaf sedge, and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production varies from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation, short growing season, and, on the Cragosen soil, also by droughtiness and rooting depth. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush

131 (continued)

management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Slope limits access by livestock and results in overgrazing of the less sloping areas.

The Coalmont soil is in capability subclass VIe, dryland; the Milren soil is in capability subclass IVe, dryland; and the Cragosen soil is in capability subclass VIIs, dryland. The Coalmont soil and the Milren soil are in the Clayey, 10 to 14-inch ppt., High Plains Southeast range site and the Cragosen soil is in the Shallow Loamy, 10 to 14-inch ppt., High Plains Southeast range site.

136=Cragosen-Carmody-Blazon complex, hilly.$T1 This map unit is on hills and ridges. Slope is 6 to 40 percent. Areas are irregular in shape and are 40 to 320 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 6,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 50 percent Cragosen gravelly loam, 6 to 40 percent slopes; 20 percent Carmody gravelly sandy loam, 6 to 40 percent slopes; and 15 percent Blazon sandy clay loam, 6 to 40 percent slopes. The Cragosen soil and Blazon soil are on hill and ridge summits and the Carmody soil is on back slopes of hills and ridges. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blackhall fine sandy loam, 6 to 40 percent slopes, and Coalmont fine sandy loam, 2 to 20 percent slopes. Also included are small areas of Bosler fine sandy loam, 1 to 8 percent slopes, and Milren sandy loam, 1 to 8 percent slopes, on fan aprons; and a soil similar to Cragosen gravelly loam, 6 to 40 percent slopes, with bedrock deeper than 20 inches. Included in some areas are Cragosen gravelly loam, 40 to 60 percent slopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Cragosen soil is shallow and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone and conglomerate. Typically, 30 percent of the surface is covered with gravel and cobbles. The surface layer is pale brown gravelly loam 2 inches thick. The upper 4 inches of the subsoil is pale brown gravelly loam. The lower part to a depth of 12 inches is light gray very gravely sandy loam. Soft sandstone is at a depth of 12 inches.

Permeability of the Cragosen soil is moderate. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is slight.

The Carmody soil is moderately deep and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is pale brown gravelly sandy loam 1 inch thick. The upper 5 inches of the underlying material is yellowish brown sandy loam. The lower part to a depth of 22 inches is very pale brown fine sandy loam. Soft sandstone is at a depth of 22 inches.

Permeability of the Carmody soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40

inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is moderate.

The Blazon soil is very shallow or shallow and well drained. It formed in residuum and slope alluvium derived dominantly from shale. Typically, the surface layer is dark yellowish brown sandy clay loam 3 inches thick. The underlying material to a depth of 15 inches is light olive gray clay loam. Soft shale is at a depth of 15 inches. In some areas the surface layer is gravelly sandy clay loam.

Permeability of the Blazon soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is moderate.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Cragosen soil is mainly 15 to 25 percent bluebunch wheatgrass, 15 to 25 percent western wheatgrass, 5 to 10 percent mutton bluegrass, and 5 to 10 percent big sagebrush. As the range condition deteriorates, threadleaf sedge and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 900 pounds of air-dry vegetation per acre in normal years. Production varies from 1,200 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Carmody soil is mainly 20 to 30 percent needleandthread, 15 to 25 percent rhizomatous wheatgrasses, 10 to 20 percent Indian ricegrass, and 5 to 10 percent silver sagebrush. As the range condition deteriorates, silver sagebrush and threadleaf sedge increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production varies from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly 20 to 40 percent rhizomatous wheatgrasses, 5 to 15 percent bluebunch wheatgrass, 5 to 10 percent bottlebrush squirreltail, and 5 to 10 percent winterfat. As the range condition deteriorates, bluegrasses and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production varies from 1,000

136 (continued)

pounds in favorable years to 500 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation, droughtiness, short growing season; and, on the Cragosen soil and Blazon soil, also by rooting depth. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include critical area planting, fencing, developing watering facilities, and wildlife habitat management. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Slope limits access by livestock and results in overgrazing of the less sloping areas.

The Cragosen soil is in capability subclass VIIs, dryland; and is in the Shallow Loamy, 10 to 14-inch ppt., High Plains Southeast range site. The Carmody soil is in capability subclass VIe, dryland; and is in the Sandy, 10 to 14-inch ppt., High Plains Southeast range site. The Blazon soil is in capability subclass VIIe, dryland; and is in the Shallow Clayey, 10 to 14-inch ppt., High Plains Southeast range site.

137--Brownsto-Lupinto complex, 6 to 40 percent slopes.

This map unit is on rolling to steep ridges and hillsides. The native vegetation is mainly short and mid grasses, forbs, and shrubs. Elevation is 5,900 to 7,000 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 40 degrees F, and the average frost-free period is 100 to 110 days.

This unit is 60 percent Brownsto cobbly loam and 25 percent Lupinto gravelly loam. Brownsto soils are on slopes of 15 to 40 percent, and Lupinto soils are on slopes of 6 to 20 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately.

Included in this unit are small areas of Blazon gravelly loam and Cragosen gravelly loam on ridges. Also included are areas of Brownsto cobbly loam with slopes less than 15 percent. A few areas have inclusions of soils with thick dark surfaces in swales which receive additional snow pack. Included areas make up 15 percent of the total acreage.

The Brownsto soil is very deep and well drained. It formed in colluvium and high energy alluvium derived from mixed sources. Typically, the surface layer is grayish brown cobbly loam about 3 inches thick. The subsoil is grayish brown gravelly loam about 4 inches thick. The upper 9 inches of the substratum is light brownish gray violently effervescent gravelly loam, the next 14 inches is light brownish gray violently effervescent very gravelly loam, and the lower part to a depth of 60 inches or more is light olive brown, violently effervescent very gravelly loam.

Permeability of the Brownsto soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is rapid and the hazard of water erosion is moderate.

The Lupinto soil is deep and well drained. It formed in gravelly alluvium derived from mixed sources. Typically, the surface layer is yellowish brown gravelly loam about 3 inches thick. The subsoil is yellowish brown gravelly clay loam about 5 inches thick. The upper 33 inches of the substratum is pale yellow, violently effervescent very gravelly loam. The lower part to a depth of 60 inches or more is very pale brown, violently effervescent very gravelly sandy loam. In some areas the surface layer is very gravelly loam.

Permeability of the Lupinto soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is rapid and the hazard of water erosion is moderate.

This unit is used mainly for livestock grazing and wildlife

habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, mutton bluegrass, needleandthread, and black sagebrush. As the range condition deteriorates, threadleaf sedge, prairie junegrass, and sagebrush increase. As the range condition further deteriorates, annuals invade. The potential plant community produces about 900 pounds of air dry vegetation in normal years. Production varies from 1,200 pounds in favorable years to 700 pounds in unfavorable years. The production of vegetation suitable for livestock grazing is limited by available water capacity. Slopes, above 30 percent, limit access by livestock and results in overgrazing of the less sloping areas. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

This unit provides food and cover for antelope and deer; for small mammals; and for sage grouse and other birds.

This map unit is in capability subclass VIe.

The Brownsto and the Lupinto soils are in the Shallow Loamy, 10- to 14-inch ppt., High Plains Southeast range site. Inclusions of Blazon and Cragosen soils in this unit are in the Shallow Loamy, 10- to 14-inch ppt., High Plains Southeast range site. Inclusions of soils with thick dark surfaces in this unit are in the Loamy, 15- to 19-inch ppt., Foothills and Mountains Southeast range site.

142=Diamondville-Forelle association, rolling.#T1' This map unit is on hillslopes and fan aprons. Slope is 2 to 15 percent. Areas are irregular in shape and are 40 to 640 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,300 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 50 percent Diamondville loam, 2 to 15 percent slopes, and 30 percent Forelle loam, 2 to 15 percent slopes. The Diamondville soil is on hillslopes. The Forelle soil is on toe slopes and fan aprons.

Included in this unit are small areas of Blackhall fine sandy loam, 5 to 45 percent slopes; Blazon clay loam, 3 to 40 percent slopes; and Carmody fine sandy loam, 2 to 40 percent slopes. Also included ar. small areas of Poposhia loam, 1 to 15 percent slopes; Rock River fine sandy loam, 1 to 8 percent slopes; and Cushool sandy loam, 2 to 15 percent slopes. The Blackhall, Blazon, Carmody, and Cushool soils are in areas of the Diamondville soil and the Poposhia and Rock River soils are in areas of the Forelle soil. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Diamondville soil is moderately deep and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is pale brown loam 2 inches thick. The upper 11 inches of the subsoil is brown and light brown clay loam. The lower part is pale brown and light yellowish brown loam 11 inches thick. Soft sandstone is at a depth of 24 inches.

Permeability of the Diamondville soil is moderately slow. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of erosion by wind is moderate.

The Forelle soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is grayish brown loam 6 inches thick. The upper 12 inches of the subsoil is brown clay loam. The next part is pale brown clay loam 4 inches thick. The lower part to a depth of 26 inches is pale brown loam. The substratum to a depth of 60 inches or more is pale brown loam.

Permeability of the Forelle soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of erosion by wind is moderate.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

142 (continued)

The potential plant community on this unit is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation and short growing season. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. (See Figure 2.) Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass IVe, dryland; and is in the Loamy, 10 to 14-inch ppt., High Plains Southeast range site.

148=Forelle-Poposhia association, 2 to 12 percent slopes.$T1 This map unit is on toe slopes and fan aprons. Areas are irregular in shape and are 80 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,300 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 45 percent Forelle loam, 2 to 8 percent slopes, and 40 percent Poposhia loam, 2 to 12 percent slopes. The Forelle soil is on fan aprons. The Poposhia soil is on toe slopes and fan aprons.

Included in this unit are small areas of Absher fine sandy loam, 1 to 8 percent slopes; Diamondville loam, 2 to 12 percent slopes on included hillslopes; and Elkol silty clay loam, 0 to 3 percent slopes. Also included are small areas of Blazon clay loam, 15 to 30 percent slopes, on included hillslopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Forelle soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown loam 2 inches thick. The upper 14 inches of the subsoil is brown clay loam. The next 8 inches is light yellowish brown loam. The substratum to a depth of 60 inches or more is very pale brown sandy loam stratified with thin lenses of loam and loamy sand.

Permeability of the Forelle soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is moderate.

The Poposhia soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown loam 3 inches thick. The subsoil is pale brown clay loam 12 inches thick. The substratum to a depth of 60 inches or more is pale brown loam.

Permeability of the Poposhia soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of erosion by wind is moderate.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Forelle soil is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, rubber rabbitbrush and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

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The potential plant community on the Poposhia soil is mainly 40 to 50 percent thickspike wheatgrass, 15 to 25 percent green needlegrass, 5 to 10 percent bluebunch wheatgrass, 5 to 10 percent bottlebrush squirreltail, and 5 to 10 percent big sagebrush. As the range condition deteriorates, rhizomatous wheatgrasses, canby bluegrass, and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,000 pounds of air-dry vegetation per acre in normal years. Production varies from 1,300 pounds in favorable years to 500 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation and short growing season. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The Forelle soil is in capability subclasses IVe, dryland; and is in the Loamy, 10 to 14-inch ppt., High Plains Southeast range site. The Poposhia soil is in capability subclass IVe, dryland; and is in the Clayey, 10 to 14-inch ppt., High Plains Southeast range site.

157 = Havre-Absher-Forelle loams, 0 to 6 percent slopes.

This map unit is on flood plains, terraces, and toe slopes. Areas are irregular in shape and are 5 to 640 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,300 to 7,500 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is about 40 percent Havre loam, 0 to 3 percent slopes; 20 percent Absher loam, 1 to 6 percent slopes; and 20 percent Forelle loam, 1 to 6 percent slopes. The Havre soil is on flood plains, the Absher soil is on terraces and toe slopes, and the Forelle soil is on toe slopes. The components of this unit occur as areas so intricately intermingled that mapping them separately was not practical at the scale used.

Included in this unit are small areas of slick spots; Alkyl silty clay loam, 0 to 3 percent slopes; Glendive sandy loam, 0 to 3 percent slopes; and Poposhia loam, 1 to 3 percent slopes. Also included are small areas of Diamondville loam, 1 to 6 percent slopes, on hillslopes and small areas of Haplaquols, 0 to 3 percent slopes and Aquic Ustifluvents, 0 to 3 percent slopes, in the DuNoir drainage area, near Dubois. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Havre soil is very deep and well drained. It formed in alluvium derived from various sources. Typically, the surface layer is brown loam 3 inches thick. The underlying material to a depth of 60 inches or more is light olive brown loam stratified with lenses of fine sandy loam, clay loam, and silty clay loam.

Permeability is moderate in the Havre soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Absher soil is very deep and well drained. It formed in alluvium derived from various sources. Typically, the surface layer is brown loam 3 inches thick. The upper 15 inches of the subsoil is brown, sodium-affected silty clay loam. The next 6 inches is grayish brown, sodium-affected silty clay loam. The substratum to a depth of 60 inches or more is pale brown silty clay loam stratified with lenses of loam, clay loam, and clay.

Permeability is very slow in the Absher soil. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion also is moderate.

157 (continued)

The Forelle soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is yellowish brown loam 8 inches thick. The upper 16 inches of the subsoil is yellowish brown clay loam. The lower 8 inches is light yellowish brown clay loam. The substratum to a depth of 60 inches or more is very pale brown clay loam.

Permeability of the Forelle soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is moderate.

This unit is used mainly for rangeland and wildlife habitat. It is also used for irrigated hay and pasture.

The potential plant community on the Havre soil is mainly 25 to 35 percent rhizomatous wheatgrasses, 10 to 20 percent slender wheatgrass, 10 to 20 percent needlegrasses, and 5 to 10 percent big sagebrush. As the range condition deteriorates, bluegrasses and big sagebrush increase in abundance. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,200 pounds in favorable years to 1,200 pounds in unfavorable years.

The potential plant community on the Absher soil is mainly 15 to 30 percent alkali sacaton, 10 to 20 percent basin wildrye, 5 to 10 percent rhizomatous wheatgrasses, and 10 to 25 percent greasewood. As the range condition deteriorates, inland saltgrass and greasewood increase in abundance. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production ranges from 2,500 pounds in favorable years to 1,200 pounds in unfavorable years.

The potential plant community on the Forelle soil is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase in abundance. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

157 (continued)

The production of vegetation suitable for grazing is limited by low precipitation and a short growing season and by alkalinity in the Absher soil. Proper grazing used and deferred grazing are needed to maintain an adequate plant cover and to control wind erosion and water erosion. Additional management practices may be needed on rangeland that is in an undesirable condition. These practices include brush management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is moderately well suited to irrigated hay and pasture. The main limitations are a short growing season and alkalinity in the absher soil. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and control erosion. Irrigation water can be applied by the flood or sprinkler method. Leveling helps to ensure a uniform application of the water. To prevent overirrigation and the leaching of plant nutrients and to control water erosion, applications of irrigation water should be adjusted to the available water capacity and rate of water intake in the soils. Annual applications of nitrogen and phosphate fertilizer are needed to maintain the production of high-quality forage.

The Havre soil is in capability subclasses IVc, nonirrigated and IIIc, irrigated. It is in the Loam Overflow, 10 to 14- inch precipitation, High Plains Southeast range site. The Absher soil is in capability subclass VIs irrigated and nonirrigated. It is in the Saline Lowland, 10- to 14- inch precipitation, High Plains Southeast range site. The Forelle soil is in capability subclasses IVe, nonirrigated and IIIe, irrigated. It is in the Loamy, 10- to 14-inch precipitation, High Plains Southeast range site.

158=Havre-Forelle-Glendive complex, 0 to 3 percent slopes.$T1 This map unit is on flood plains and toe slopes. Areas are long and narrow in shape and are 30 to 400 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,300 to 7,000 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 45 percent Havre loam, 0 to 3 percent slopes; 20 percent Forelle loam, 1 to 3 percent slopes; and 15 percent Glendive sandy loam, 0 to 3 percent slopes. The Havre and Glendive soils are on flood plains and the Forelle soil is on toe slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bosler sandy loam, 1 to 3 percent slopes, and Rock River sandy loams, 1 to 3 percent slopes. Also included is a somewhat poorly drained soil coarse textured soil in the Green Mountain area. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Havre soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown loam 4 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown and light yellowish brown sandy clay loam stratified with lenses of very fine sandy loam, fine sandy loam, and clay loam.

Permeability of the Havre soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is moderate. The Havre soil receives additional moisture as run-in from higher lying areas.

The Forelle soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is very pale brown loam 5 inches thick. The subsoil is pale brown clay loam 14 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam.

Permeability of the Forelle soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is moderate.

The Glendive soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown sandy loam 4 inches thick. The underlying material to a depth of 60 inches or more is pale brown sandy loam stratified with thin lenses of loamy sand, loam, and sandy clay loam.

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Permeability of the Glendive soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is severe. The Glendive soil receives additional moisture as run-in from higher lying areas.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

$I01The potential plant community on the Havre soil and the Glendive soil is mainly 25 to 35 percent rhizomatous wheatgrasses, 10 to 20 percent slender wheatgrass, 10 to 20 percent needlegrasses, and 5 to 10 percent big sagebrush. As the range condition deteriorates, bluegrasses and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,800 pounds of air-dry vegetation per acre in normal years. Production varies from 2,200 pounds in favorable years to 1,200 pounds in unfavorable years.

The potential plant community on the Forelle soil is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, rabbitbrush and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation and short growing season. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass IVc, dryland. The Havre soil and the Glendive soil are in the Loamy Overflow, 10 to 14-inch ppt., High Plains Southeast range site. The Forelle soil is in the Loamy, 10 to 14-inch ppt., High Plains Southeast range site.

174=Milren-Bosler-Rock River sandy loams, 1 to 12 percent slopes.$T1 This map unit is on terraces and fan aprons. Areas are irregular in shape and are 100 to 1,200 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 6,500 to 7,500 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 45 percent Milren sandy loam, 1 to 8 percent slopes; 20 percent Bosler sandy loam, 1 to 8 percent slopes; and 15 percent Rock River sandy loam, 1 to 12 percent slopes. The Milren soil and Bosler soil are on terraces and the Rock River soil is on fan aprons. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blackhall fine sandy loam, 5 to 30 percent slopes, on included hills; Cragosen gravelly loam, 5 to 45 percent slopes, on included hills and escarpments; and Diamondville sandy clay loam, 1 to 15 percent slopes, on hillslopes and fan aprons. Also included are small areas of Milvar stony loam, 1 to 6 percent slopes, in areas of the Milren soil. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Milren soil is very deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown sandy loam 2 inches thick. The subsurface layer is pale brown sandy loam 1 inch thick. The upper 8 inches of the subsoil is brown sandy clay. The next 5 inches is pale brown sandy clay loam. The lower part to a depth of 23 inches is very pale brown loam. The upper 33 inches of the substratum is very pale brown and pale brown fine sandy loam. The lower part to a depth of 60 inches or more is very pale brown loamy fine sand. In some areas the surface layer is loam or sandy clay loam.

Permeability of the Milren soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is moderate.

The Bosler soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, 15 percent of the surface is covered with gravel. The surface layer is yellowish brown sandy loam 2 inches thick. The upper 18 inches of the subsoil is dark yellowish brown sandy clay loam. The lower part to a depth of 60 inches or more is light gray very gravelly loamy sand. In some areas the surface layer is loam or sandy clay loam.

Permeability of the Bosler soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is severe.

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The Rock River soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is brown sandy loam 3 inches thick. The upper part of the subsoil is dark yellowish brown sandy clay loam 12 inches thick. The lower part to a depth of 34 inches is pale brown sandy clay loam. The substratum to a depth of 60 inches or more is pale brown sandy clay loam.

Permeability of the Rock River soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of erosion by water is slight. The hazard of erosion by wind is severe.

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Milren soil is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, big sagebrush and rabbitbrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Bosler soil and the Rock River soil is mainly 20 to 30 percent needleandthread, 15 to 25 percent rhizomatous wheatgrasses, 10 to 20 percent Indian ricegrass , and 5 to 10 percent silver sagebrush . As the range condition deteriorates, threadleaf sedge and silver sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production varies from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation and short growing season. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush management, critical area planting, fencing, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass IVe, dryland. The Milren soil is in the Loamy, 10 to 14-inch ppt., High Plains Southeast range site. The Bosler soil and the Rock River soil are in the Sandy, 10 to 14-inch ppt., High Plains Southeast range site.

186=Poposhia-Blazon-Carmody complex, hilly.$T1 This map unit is on hills, ridges, and fan aprons. Slope is 3 to 40 percent. Areas are irregular in shape and are 20 to 500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,300 to 7,000 feet. The annual precipitation is 10 to 14 inches, the annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is 35 percent Poposhia loam, 3 to 20 percent slopes; 30 percent Blazon clay loam, 6 to 40 percent slopes; and 15 percent Carmody fine sandy loam, 3 to 25 percent slopes. The Poposhia soil is on fan aprons. The Blazon soil and Carmody soil are on hills and ridges. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Blackhall sandy loam, 5 to 40 percent slopes; Diamondville loam, 3 to 15 percent slopes; Forelle loam, 3 to 20 percent slopes; and Cushool sandy loam, 3 to 20 percent slopes. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Poposhia soil is very deep and well drained. It formed in alluvium derived dominantly from mixed sources. Typically, the surface layer is yellowish brown loam 3 inches thick. The upper subsoil is light olive brown loam 7 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown clay loam.

Permeability of the Poposhia soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of erosion by wind is moderate.

The Blazon soil is very shallow or shallow and well drained. It formed in residuum and slope alluvium derived dominantly from soft shale. Typically, the surface layer is dark yellowish brown clay loam 4 inches thick. The underlying material to a depth of 17 inches is yellowish brown and light olive brown clay loam. Soft shale is at a depth of 17 inches.

Permeability of the Blazon soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of erosion by water is severe. The hazard of erosion by wind is moderate.

The Carmody soil is moderately deep and well drained. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is brown fine sandy loam 5 inches thick. The underlying material to a depth of 28 inches is light yellowish brown fine sandy loam. Soft sandstone is at a depth of 28 inches.

Permeability of the Carmody soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of erosion by wind is severe.

186 (continued)

This unit is used mainly for rangeland. It is also used for wildlife habitat.

The potential plant community on the Poposhia soil is mainly 30 to 40 percent western wheatgrass, 5 to 15 percent needleandthread, 5 to 15 percent bluebunch wheatgrass, and 5 to 15 percent big sagebrush. As the range condition deteriorates, rabbitbrush and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,100 pounds of air-dry vegetation per acre in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Blazon soil is mainly 20 to 40 percent rhizomatous wheatgrasses, 5 to 15 percent bluebunch wheatgrass, 5 to 10 percent bottlebrush squirreltail, and 5 to 10 percent winter fat. As the range condition deteriorates, bluegrasses and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production varies from 1,000 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community on the Carmody soil is mainly 20 to 30 percent needleandthread, 15 to 25 percent rhizomatous wheatgrasses, 10 to 20 percent Indian ricegrass, and 5 to 10 percent big sagebrush . As the range condition deteriorates, threadleaf sedge and big sagebrush increase. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 1,200 pounds of air-dry vegetation per acre in normal years. Production varies from 1,500 pounds in favorable years to 700 pounds in unfavorable years.

The production of vegetation suitable for livestock grazing is limited by low precipitation and, on the Blazon soil and Carmody soil, also by rooting depth and droughtiness. Rangeland management practices such as proper grazing use and deferred grazing are needed to maintain an adequate plant cover and protect the soil from erosion by wind and water. Additional management practices may be needed on rangeland that has deteriorated to an undesirable condition. These practices include brush management, critical area planting, livestock exclusion, fencing, prescribed burning, developing watering facilities, and wildlife habitat management. Areas where brush is managed need to have enough ground cover remaining to prevent erosion. Range seeding may be needed if a sufficient amount of desirable plants is not present to adequately seed the area naturally. Delay grazing until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Slope limits access by livestock in the steeper areas and results in overgrazing of the less sloping areas.

186 (continued)

The Poposhia soil is in capability subclass VIe, dryland; and is in the Loamy, 10 to 14-inch ppt., High Plains Southeast range site. The Blazon soil is in capability subclass VIIe, dryland; and is in the Shallow Clayey, 10 to 14-inch ppt., High Plains Southeast range site. The Carmody soil is in capability subclass VIe, dryland; and is in the the Sandy, 10 to 14-inch ppt., High Plains Southeast range site.

208=Sinkson-Almy-Thermopolis association, rolling.

This map unit is on hills, ridges and fan aprons. Slopes are 2 to 30 percent. Areas are irregular in shape and are 5 to 640 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 5,500 to 7,800 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is about 45 percent Sinkson loam, 2 to 15 percent slopes; 20 percent Almy loam, 2 to 10 percent slopes; and 20 percent Thermopolis loam, 10 to 30 percent slopes. The Sinkson and Almy soils are on fan aprons, and the Thermopolis soil is on hills and ridges.

Included in this unit are small areas of Blackhall fine sandy loam, 5 to 30 percent slopes; Carmody fine sandy loam, 2 to 30 percent slopes; and Rock outcrop on hills and ridges adjacent to the Thermopolis soil. Also included are small areas of Diamondville loam, 2 to 15 percent slopes; Forelle loam, 2 to 15 percent slopes; Poposhia loam, 1 to 15 percent slopes; and Tisworth loam, 2 to 8 percent slopes, adjacent to the Sinkson and Almy soils. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Sinkson soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone and siltstone. Typically, the surface layer is reddish brown loam 4 inches thick. The underlying material to a depth of 60 inches or more is reddish brown and yellowish red silt loam.

Permeability is moderate in the Sinkson soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion also is moderate.

The Almy soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone interbedded with shale. Typically, the surface layer is yellowish brown loam 2 inches thick. The upper 8 inches of the subsoil is reddish brown loam. The next 10 inches is reddish brown clay loam. The lower 10 inches is light reddish brown loam. The substratum to a depth of 60 inches or more is yellowish red loam.

Permeability is moderate in the Almy soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion also is moderate.

The Thermopolis soil is very shallow or shallow and is well drained. It formed in residuum and slope alluvium derived dominantly from sandstone and siltstone. Typically, the surface layer is red loam 3 inches thick. The underlying material also is red loam. It is 13 inches thick. Soft siltstone bedrock is at a depth of about 16 inches.

208 (continued)

Permeability is moderate in the Thermopolis soil. Available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

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

The potential plant community on the Sinkson and Almy soil is mainly 20 to 30 percent rhizomatous wheatgrasses, 5 to 15 percent needleandthread, 5 to 15 percent big sagebrush. As the range condition deteriorates, sedges and big sagebrush increase in abundance. As the range condition further deteriorates, pricklypear and annual grasses and weeds invade. The potential plant community produces about 800 pounds of air-dry vegetation per acre in normal years. Production ranges from 1,100 pounds in favorable years to 500 pounds in unfavorable years.

The potential plant community of the Thermopolis soil is mainly 20 to 35 percent bluebunch wheatgrass, 10 to 20 percent rhizomatous wheatgrasses, 5 to 15 percent needlegrasses, and 5 to 10 percent black sagebrush. As the range condition deteriorates, bluegrasses, sedges, and black sagebrush increase in abundance. As the range condition further deteriorates, annual grasses and weeds invade. The potential plant community produces about 500 pounds of air-dry vegetation per acre in normal years. Production ranges from 700 pounds in favorable years to 350 pounds in unfavorable years.

The production of vegetation suitable for grazing is limited by low precipitation and a short growing season and by doughtiness and the restricted rooting depth in the Thermopolis soil. Proper grazing use and deferred grazing are needed to maintain an adequate plant cover and to control wind erosion and water erosion. Additional management practices may be needed on rangeland that is in an undesirable condition. The practices include brush control, critical area planting, fencing, watering facilities, and wildlife habitat management. Range seeding may be needed on the Sinkson and Almy soils if the amount of desirable vegetation is not sufficient for natural seeding to occur. Because of the slope, the restricted depth to bedrock, and doughtiness, the Thermopolis soil is poorly suited to range seeding that involves tillage. Access by livestock is limited in the steeper areas. As a result, the less sloping areas tend to be overgrazed.

The Sinkson and Almy soils are in capability subclass IVe, nonirrigated. They are in the Loamy, 10 to 14-inch precipitation, Foothills and Basins East range site. The Thermopolis soil is in capability subclass VIe, nonirrigated. It is in the Shallow Loamy, 10 to 14-inches precipitation, Foothills and Basins East range site.

229 - Pits and Dumps

This map unit consists of areas where past mining activities have occurred and sites where mining or reclamation are currently proceeding. Included are pits, stockpiles, sediment control structures, roads, etc. Topsoil occurs in stockpiles or may have been replaced on some small areas during reclamation. This unit also includes small areas of undisturbed lands but these were too small to map out at the scale used.

256--Rock outcrop-Ustic Torriorthents, shallow-Rubble land complex, 30 to 100 percent slopes.

This map unit is on steep to extremely steep escarpments and hogbacks. The native vegetation is mainly short and mid grasses, shrubs, and trees. Elevation is 5,300 to 7,500 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 37 to 50 degrees F, and the average frost-free period is 90 to 130 days.

This unit is about 40 percent Rock outcrop, 25 percent Ustic Torriorthents, shallow, and 15 percent rubble land. Rock outcrop and Ustic Torriorthents are intermingled on steep slopes of 30 to 100 percent and rubble land is on lower colluvial slopes.

Included in this unit is about 5 percent moderately deep and deep soils in pockets associated with rubble land, and 15 percent soils underlain by hard bedrock similar to Ustic Torriorthents, shallow. Percentages vary from one area to another.

Typically, Rock outcrop is ledges and escarpments of sedimentary rock.

The Ustic Torriorthents, shallow, soils are shallow to very shallow and well to excessively drained. They formed in residuum or colluvium derived dominantly from sedimentary rock. In a reference pedon the surface layer is yellowish brown loam about one inch thick. The subsurface layer is yellowish brown clay loam about 3 inches thick. The substratum is pale brown clay loam about 6 inches thick over interbedded siltstone and shale at 10 inches. Textures are sandy loam to clay. Rock fragments range from 0 to 60 percent. Reaction is neutral to strongly alkaline. Textures and other soil properties vary from one area to another. Most uses are severely limited by slope and depth to bedrock.

Permeability of the Ustic Torriorthents, shallow, soil is slow to moderately rapid. Available water capacity is low to very low. Effective rooting depth is 3 to 20 inches. Runoff is rapid and the hazard of water erosion is moderate to severe.

Typically, rubble land is colluvial boulders and stones.

This unit is used for wildlife habitat. Livestock grazing on this unit is limited by boulders and steep slopes.

The potential plant community on the Ustic Torriorthents, shallow, soil is mainly bluebunch wheatgrass and woody plants.

This unit provides food and cover for antelope and deer; for small mammals; and for sage grouse and other birds.

256 (continued)

This map unit is in capability subclass VIII.

The Ustic Torriorthents, shallow, are mainly in the Very Shallow , 10- to 14-inch ppt., High Plains Southeast range site, however, plant communities are highly erratic.

Stunner-Pinelli

280--Stunner-Pinelli complex, 3 to 15 percent slopes.

This map unit is on rolling plateaus. The native vegetation is mainly mid grasses, forbs, and shrubs. Elevation is 6,300 to 7,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 37 to 42 degrees F, and the average frost-free period is 90 to 110 days.

This unit is about 50 percent Stunner sandy loam and 30 percent Pinelli clay loam. Stunner soil is on convex slopes of 3 to 15 percent, and Pinelli soil is on concave slopes of 3 to 10 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately.

Included in this unit is about 10 percent Brownsto gravelly loam on ridges and shoulders and 10 percent deep stony clay soils in nearly level drainage bottoms.

The Stunner soil is deep and well drained. It formed in calcareous alluvium derived from mixed sources. Typically, the surface layer is grayish brown sandy loam about 3 inches thick. The upper 14 inches of the subsoil is brown clay loam. The lower 5 inches is yellowish brown clay loam. The substratum is light gray loam to a depth of 60 inches or more. In some areas the surface layer is loam.

Permeability of the Stunner soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium and the hazard of water erosion is moderate.

The Pinelli soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is grayish brown clay loam about 3 inches thick. The upper 19 inches of the subsoil is brown silty clay. The lower 8 inches is light brownish gray clay loam. The substratum to a depth of 60 inches or more is pale brown loam. In some areas the surface layer is loam.

Permeability of the Pinelli soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of water erosion is slight.

This unit is used mainly for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly rhizomatous wheatgrass, needleandthread, mutton bluegrass and big sagebrush. As the range condition deteriorates, big sagebrush and blue grama increase. As the range condition further deteriorates, annuals invade. The potential plant

community produces about 1,100 pounds of air dry vegetation in normal years. Production varies from 1,400 pounds in favorable years to 600 pounds in unfavorable years.

This unit provides food and cover for antelope and deer; for small mammals; and for sage grouse and other birds.

This map unit is in capability subclass IVe.

The Stunner and Pinelli soils are in the Loamy 10- to 14-inch ppt., High Plains Southeast range site. Inclusions of Brownsto and stony clay soils in this unit are in the Shallow Loamy 10- to 14-inch ppt., High Plains Southeast range site.

ADDENDUM D7-5
SCS SOILS SERIES DESCRIPTION

APPENDIX D7-5

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Absher Series

The Absher series consists of very deep, well drained soils on fan aprons, toe slopes, and terraces. These soils formed in alluvium derived from various sources. Slopes are 0 to 8 percent. Elevation is 5,300 to 8,000 feet. The annual precipitation is 9 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 80 to 110 days.

Typical pedon of an Absher loam that has a slope of 2 percent, in an area of Havre-Absher-Forelle loams, 0 to 6 percent slopes; about 400 feet east and 2,600 feet south of the northwest corner of sec. 21, T.33N., R. 98 W.

E=0 to 3 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate thin platy structure parting to moderate very fine angular blocky; soft, very friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; slightly effervescent; disseminated carbonates; moderately alkaline; abrupt smooth boundary.

Bt=3 to 6 inches; brown (10 YR 4/3) silty clay loam, brown (10 YR 4/3) moist; moderate medium prismatic structure parting to moderate fine angular blocky; hard, firm, sticky and very plastic; continuous thick clay films on faces of peds; many very fine and fine and few medium roots; slightly effervescent; disseminated carbonates; moderately alkaline; clear wavy boundary.

Btn=6 to 12 inches; brown (10 YR 4/3) silty clay loam, brown (10 YR 4.3) moist, moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; continuous thick clay films on faces of peds; common very fine and fine and few medium roots; strongly effervescent; disseminated carbonates; exchangeable sodium percentage of more than 15; very strongly alkaline; clear wavy boundary.

Btnk=12 to 18 inches; brown (10 YR 4/3) silty clay loam, brown (10 YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; continuous thin clay films on faces of peds; common very fine, fine, and medium roots; strongly effervescent; disseminated carbonates and common fine soft masses of carbonates; exchangeable sodium percentage of more than 15; very strongly alkaline; clear wavy boundary.

Bk1=18 to 24 inches; grayish brown (10YR 5/2) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and very plastic; few very fine, fine, and medium roots; strongly effervescent; disseminated carbonates; very strongly alkaline; gradual wavy boundary.

Absher (continued)

Bk2=24 to 60 inches; pale brown (10YR 6/3) silty clay loam stratified with lenses of loam, clay, and clay loam; grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and plastic, few very fine, fine and medium roots to a depth of 30 inches; strongly effervescent; disseminated carbonates and common fine soft masses of carbonates in some lenses; very strongly alkaline.

The E horizon is neutral to moderately alkaline. The Bt and Btn horizons have hue of 2.5Y to 7.5YR. The Bt horizon is clay, silty clay, silty clay loam, or clay loam. The Btn and Bk horizons are strongly alkaline or very strongly alkaline. The Btn horizon is clay loam, silty clay loam, silty clay, or clay. The Bk horizon has hue of 2.5Y or 10YR. It is dominantly silty clay loam, clay loam, or clay, but in some pedons it has thin strata of loam.

Almy Series

The Almy series consists of very deep, well drained soils on fan aprons. These soils formed in alluvium derived dominantly from sandstone interbedded with shale. Slopes are 0 to 10 percent. Elevation is 5,400 to 7,800 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typical pedon of an Almy loam that has a slope of 2 percent, in an area of Almy-Monbutte-Rallod complex, 1 to 10 percent slopes, about 1,800 feet north and 3,200 feet east of the southwest corner of sec. 6, T. 33 N., R.96W.

A=0 to 2 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine and medium roots; many very fine and fine vesicular pores; mildly alkaline; clear smooth boundary.

Bt1=2 to 5 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist, moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, firm, sticky and plastic; continuous thick clay films on faces of peds; many very fine, fine and medium roots; moderately alkaline; abrupt wavy boundary.

Bt2=5 to 18 inches; yellowish red (5YR 4/6) clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few thin clay films on faces of peds; common very fine, fine and medium roots; moderately alkaline; clear wavy boundary.

Btk=18 to 23 inches; light reddish brown (5YR 6.3) sandy clay loam, reddish brown (5YR 4.3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; few thin clay films on faces of peds; few very fine, fine and medium roots, strongly effervescent; disseminated carbonates and common medium seams and soft masses of carbonates; moderately alkaline; clear wavy boundary.

Bk=23 to 28 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine, fine and medium roots; violently effervescent; disseminated carbonates and common medium soft masses of carbonates; moderately alkaline; gradual wavy boundary.

Almy (continued)

C=28 to 60 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; slightly effervescent; disseminated carbonates; moderately alkaline.

The A horizon has hue of 10YR to 5YR. It is 0 to 25 percent gravel. It is mildly alkaline or moderately alkaline. The Bt, Bk, and C horizons have hue of 5YR or 2.5YR. The Bt and Bk horizons are sandy clay loam, clay loam, or loam. The Bt horizon is 20 to 35 percent clay. It is mildly alkaline to strongly alkaline. The Bk horizon is moderately alkaline or strongly alkaline. The C horizon is dominantly sandy clay loam or loam. In some pedons, however, it is gravelly sandy loam below a depth of 40 inches. It is moderately alkaline to very strong alkaline.

Blazon Series

The Blazon series consists of very shallow or shallow, well drained soils on hills, ridges, and knobs. These soils formed in residuum and slope alluvium derived dominantly from soft shale. Slopes are 3 to 40 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Blazon clay loam, 20 percent slope in an area of Blazon-Rock outcrop-Carmody complex, hilly, about 200 feet north and 200 feet west of the southeast corner of section 17, T33N, R98W.

A=0 to 2 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; weak fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine and fine roots; slightly effervescent, carbonates disseminated; moderately alkaline; abrupt smooth boundary.

C1=2 to 14 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium platy structure parting to weak fine subangular blocky; slightly hard, friable, sticky, plastic; common very fine and fine roots; 10 percent fine soft shale fragments; slightly effervescent, carbonates disseminated; moderately alkaline; gradual wavy boundary.

C2=14 to 19 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; slightly effervescent, carbonates disseminated; many fine crystals of gypsum; moderately alkaline; abrupt wavy boundary.

Cr=19 inches; soft sandy shale.

Depth to bedrock is 4 to 20 inches.

A horizon: Hue is 2.5Y or 10YR. Reaction is moderately alkaline or strongly alkaline. The horizon contains less than 5 percent rock fragments.

C horizons: Hue is 5Y through 10YR. Clay content is 27 to 35 percent.

Bosler Series

The Bosler series consists of very deep, well drained soils on fan aprons and terraces. These soils formed in alluvium derived from mixed sources. Slope is 1 to 8 percent. Elevation is 6,000 to 7,800 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Bosler fine sandy loam, 1 percent slope in an area of Bosler-Ryan Park fine sandy loams, 1 to 8 percent slopes, about 40 feet east and 10 feet south of the northwest corner of section 15, T29N, R92W.

About 10 percent of the surface is covered with gravel.

A=0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine, fine, and medium roots; mildly alkaline; clear smooth boundary.

Bt=6 to 13 inches; brown (7.5YR 5/4) sandy clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very friable, slightly sticky, slightly plastic; many very fine, fine and medium roots; continuous thin clay films on faces of peds, few thin clay films bridging sand grains; mildly alkaline; clear wavy boundary.

Btk=13 to 20 inches; brown (10YR 5/3) gravelly sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, very friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 15 percent gravel; slightly effervescent, moderately alkaline; abrupt wavy boundary.

2Bk1=20 to 23 inches; very pale brown (10YR 7/3) very gravelly loamy sand, pale brown (10YR 6/3) moist; massive; hard, very friable, nonsticky, nonplastic; few very fine, fine, and medium roots; 45 percent gravel, 5 percent cobbles; violently effervescent, carbonates disseminated and as common fine threads and soft masses; moderately alkaline; abrupt broken boundary.

2Bk2=23 to 60 inches; pale brown (10YR 6/3) very gravelly loamy sand, brown (10YR 5/3) moist; single grain; slightly hard, weakly cemented by carbonates, very friable; nonsticky, nonplastic; 50 percent gravel, 5 percent cobbles; strongly effervescent; carbonates disseminated; strongly alkaline.

Bosler (continued)

Depth to the 2Bk horizon ranges from 20 to 40 inches.

A horizon: The horizon is 0 to 10 percent gravel. Reaction is mildly alkaline or moderately alkaline.

Bt horizon: Hue is 10YR or 7.5YR. Clay content is 20 to 35 percent. Reaction is mildly alkaline or moderately alkaline.

2Bk horizon: Hue is 2.5Y or 10YR. Texture is very gravelly sand, or very gravelly loamy sand. Rock fragment content is 35 to 60 percent. Reaction is moderately alkaline or strongly alkaline.

Brownsto Series

The Brownsto series consists of very deep, well drained soils on glacial moraines, terraces and fan aprons. These soils formed in alluvial and glacial deposits derived from various sources. Slopes are 0 to 50 percent. Elevation is 6,000 to 7,500 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 80 to 110 days.

Typical pedon of a Brownsto loam that has a slope of 1 percent, in an area of Brownsto loam, 0 to 6 percent slopes; about 1,450 feet east and 1,300 feet north of the southwest corner of sec. 28, T42N R105W.

A=0 to 2 inches; light yellowish brown (10YR 6/4) loam, brown (7.5YR 4/4) moist; weak thin platy structure parting to moderate fine granular; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; about 5 percent gravel; mildly alkaline; abrupt smooth boundary.

Bw1=2 to 7 inches; brown (7.5YR 4/4) loam, brown (7.5YR 4/4) moist; weak course prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common fine and many very fine roots; about 5 percent gravel; slightly effervescent; disseminated carbonates; mildly alkaline; clear wavy boundary.

Bw2=7 to 9 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist, weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; about 5 percent gravel; violently effervescent, disseminated carbonates; moderately alkaline; clear wavy boundary.

Bk1=9 to 27 inches; very pale brown (10YR 8/3) very gravelly sandy loam, very pale brown (10YR 7/3) moist; massive; hard, very friable, nonsticky and nonplastic; few fine and very fine roots; about 50 percent gravel and 10 percent cobbles; violently effervescent; disseminated carbonates, may large irregular soft masses and seams of carbonates, and many thick coatings of carbonates on the bottom of coarse fragments; moderately alkaline; gradual wavy boundary.

Brownsto Series (continued)

Bk2=27 to 60 inches; brown (7.5YR 5/4) very gravelly sandy loam that has discontinuous strata of gravelly sandy loam and very gravelly sand; brown (7.5YR 5/4) moist; massive; hard, firm, nonsticky and nonplastic; few medium and many very fine and fine roots to a depth of 34 inches; about 50 percent gravel and 10 percent cobbles; weakly cemented with calcium carbonate; strongly effervescent; large irregular soft masses and seams of carbonates; moderately alkaline.

The calcium carbonate equivalent is 15 to 40 percent in the calcic horizon.

The A and Bw horizons have hue of 10YR or 7.5YR. They are mildly alkaline or moderately alkaline. The A horizon is 5 to 40 percent rock fragments. The Bw horizon is fine sandy loam, loam, sandy clay loam, gravelly sandy clay loam, or gravelly loam. It is 5 to 25 percent rock fragments.

The Bk horizon has hue of 2.5Y to 7.5YR. It is very cobbly sandy clay loam, very gravelly sandy clay loam, very gravelly loam, very gravelly sandy loam, very cobbly sandy loam, or very gravelly fine sandy loam. Some pedons have thin lenses that are 15 to 35 percent rock fragments. The average content of rock fragments is 35 to 65 percent. Reaction is moderately alkaline or strongly alkaline.

Carmody Series

The Carmody series consists of moderately deep, well drained soils on hills, ridges, and knobs. These soils formed in residuum and slope alluvium derived dominantly from sandstone. Slope is 2 to 40 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Carmody fine sandy loam, 4 percent slope in an area of Blackhall-Carmody association, hilly, about 1,800 feet south and 1,150 feet east of the northwest corner of section 30, T34N, R95W.

A=0 to 4 inches; brown (10YR 5/3) fine sandy loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; loose, nonsticky, nonplastic; many very fine and fine roots; slightly effervescent, carbonates disseminated; moderately alkaline; abrupt smooth boundary.

C1=4 to 13 inches; pale brown (10YR 6/3) very fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; slightly effervescent, carbonates disseminated; moderately alkaline; clear wavy boundary.

C2=13 to 24 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam, light olive brown (2.5Y 5/4) moist; single grain; loose, nonsticky, nonplastic; few very fine and fine roots; strongly effervescent, carbonates disseminated; moderately alkaline; gradual wavy boundary.

Cr=24 inches; soft sandstone.

Bedrock is at a depth of 20 to 40 inches. The control section is 10 to 18 percent clay.

C horizons: Hue is 2.5Y or 10YR. Texture is sandy loam, fine sandy loam or very fine sandy loam. Reaction is moderately alkaline or strongly alkaline.

Coalmont Series

$I01The Coalmont series consists of moderately deep, well drained soils on ridges and hill slopes. These soils formed in residuum and slope alluvium derived dominantly from shale interbedded with sandstone.Slope is 2 to 20 percent. Elevation is 6,300 to 7,500 feet. Annual precipitation is 10 to 14 inches and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Coalmont loam, 15 percent slope in an area of Coalmont-Milren-Cragosen complex, rolling, about 200 feet north and 2,300 feet west of the southeast corner of section 15, T32N, R93W.

A=0 to 2 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium granular structure; hard, firm, sticky, plastic; common very fine, fine, and medium roots; mildly alkaline; abrupt smooth boundary.

Bt=2 to 16 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; moderate medium prismatic structure parting to moderate medium and fine angular blocky; very hard, firm, very sticky, very plastic; common very fine, fine, and medium roots; continuous thin and few thick clay films on vertical faces of peds; slightly effervescent; carbonates disseminated; mildly alkaline; clear wavy boundary.

Bk=16 to 23 inches; olive (5Y 5/3) clay loam, olive (5Y 5/3) moist; moderate medium and fine angular blocky structure; hard, firm, sticky, plastic; few very fine and fine roots; violently effervescent, many medium soft masses and seams of carbonates; few fine crystals of gypsum; moderately alkaline; gradual wavy boundary.

Cy=23 to 30 inches; olive (5Y 5/3) clay loam, olive (5Y 5/6) moist; common medium strong brown (7.5YR 5/6) mottles; moderate medium angular blocky rock structure; hard, firm, sticky, plastic; strongly effervescent, carbonates disseminated; few small soft masses of gypsum; moderately alkaline; gradual wavy boundary.

Cr=30 inches; soft shale.

Bedrock is at a depth of 20 to 40 inches. Depth to the base of the argillic horizon ranges from 13 to 21 inches.

A horizon: Hue is 2.5Y or 10YR. Rock fragment content is 0 to 15 percent.

Bt horizon: Hue is 5Y through 10YR. Texture is clay loam or clay. Clay content is 35 to 50 percent. Rock

Coalmont (continued)

fragment content is 0 to 15 percent. Reaction is mildly alkaline or moderately alkaline.

Bk and C horizon: Hue is 5Y through 10YR. Texture is clay or clay loam. Rock fragment content is 0 to 15 percent.

Cragosen Series

The Cragosen series consists of shallow, well drained soils on hills, terrace escarpments, and ridges. These soils formed in residuum and slope alluvium derived dominantly from sandstone and conglomerate. Slope is 5 to 60 percent. Elevation is 6,000 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Cragosen gravelly loam, 20 percent slope in an area of Cragosen-Carmody-Blazon complex, hilly, about 1,100 feet south and 3,200 feet west of the northeast corner of section 16, T33N, R89W.

About 30 percent of the surface is covered with gravel and cobbles.

A=0 to 2 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky, slightly plastic; many very fine, fine and medium roots; 20 percent gravel, 5 percent cobbles; strongly effervescent, carbonates disseminated; moderately alkaline; abrupt smooth boundary.

Bw=2 to 6 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; weak fine subangular blocky structure parting to moderate very fine subangular blocky; slightly hard, very friable, slightly sticky, slightly plastic; many very fine, fine and medium roots; 25 percent gravel, 5 percent cobbles; strongly effervescent, carbonates disseminated; moderately alkaline; clear wavy boundary.

Bk=6 to 12 inches; light gray (2.5Y 7/2) very gravelly sandy loam, light brownish gray (2.5Y 6/2) moist; hard, very friable, nonsticky, nonplastic; few very fine, fine, and medium roots; 40 percent gravel, 5 percent cobbles; strongly effervescent, carbonates disseminated and as common large seams and soft masses; moderately alkaline; abrupt wavy boundary.

Cr=12 inches; soft sandstone.

Bedrock is at a depth of 10 to 20 inches. The control section is 25 to 45 percent gravel, 5 to 20 percent cobbles, and 10 to 18 percent clay. Thirty to 60 percent of the surface is covered with gravel and cobbles.

A horizon: Hue is 10YR or 7.5YR. Reaction is mildly alkaline or moderately alkaline.

Bw horizon: Rock fragment content is 25 to 60 percent. Reaction is mildly alkaline or moderately alkaline.

Cragosen (continued)

Bk horizon: Hue is 5Y through 10YR. Texture is very gravelly loam or very gravelly sandy loam. Rock fragment content is 35 to 60 percent. Reaction is mildly alkaline through strongly alkaline.

Diamondville Series

The Diamondville series consists of moderately deep, well drained soils on hill slopes. These soils formed in residuum and slope alluvium derived dominantly from sandstone. Slope is 1 to 15 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 9 to 14 inches, and mean annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Diamondville loam, 4 percent slope in an area of Diamondville-Forelle association, rolling, about 2,200 feet south and 1,600 feet east of the northwest corner of section 24, T33N, R97W.

A=0 to 2 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak very thin platy structure parting to weak very fine granular; soft, very friable, nonsticky, nonplastic; many very fine, fine, and medium roots; many very fine and fine vesicular pores; mildly alkaline; abrupt smooth boundary.

Bt1=2 to 6 inches; brown (7.5YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure parting to weak very fine subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; few thin clay films on vertical faces of peds; many very fine, fine and medium roots; mildly alkaline; clear wavy boundary.

Bt2=6 to 13 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; moderate prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky, plastic; continuous thick clay films on faces of peds; common very fine, fine and medium roots; moderately alkaline; clear wavy boundary.

Btk=13 to 18 inches; pale brown (10YR 6/3) loam, brown (7.5YR 5/4) moist; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; few thin clay films on vertical faces of peds; common fine and medium roots; violently effervescent, carbonates disseminated and as common fine soft masses and seams; moderately alkaline; clear wavy boundary.

Bk=18 to 24 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine, and medium roots; violently effervescent, carbonates disseminated and as many medium soft masses and seams; strongly alkaline; abrupt wavy boundary.

Diamondville (continued)

Cr=24 inches; yellow soft sandstone.

Bedrock is at a depth of 20 to 40 inches. Depth to uniformly calcareous material is 12 to 18 inches.

A horizon: Reaction is neutral or mildly alkaline.

Bt horizons: Hue is 7.5YR or 10YR. Texture is sandy clay loam or clay loam. The control section is 20 to 35 percent clay. Reaction is mildly alkaline or moderately alkaline.

Bk horizon: Hue is 2.5Y or 10YR. The horizon is 0 to 15 percent gravel. Texture is loam, sandy loam, or sandy clay loam. Reaction is moderately alkaline or strongly alkaline.

Forelle Series

The Forelle series consists of very deep, well drained soils on fan aprons, terraces, and toe slopes. These soils formed in alluvium derived from mixed sources. Slope is 1 to 15 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 80 to 110 days.

Typical pedon of Forelle loam, 3 percent slope in an area of Diamondville-Forelle association, rolling, about 1,050 feet north and 1,100 feet east of the southwest corner of section 11, T33N, R98W.

A1=0 to 2 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine and fine and common medium roots; mildly alkaline; abrupt smooth boundary.

A2=2 to 6 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate thin platy structure parting to weak fine granular; slightly hard, very friable, slightly sticky, slightly plastic; many very fine and fine and common medium roots; mildly alkaline; abrupt smooth boundary.

Bt1=6 to 10 inches; brown (7.5YR 5/4) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable, sticky, plastic; continuous thick clay films on faces of peds; common very fine, fine, and medium roots; mildly alkaline; clear wavy boundary.

Bt2=10 to 18 inches; brown (7.5YR 5/4) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to strong fine subangular blocky; hard, friable, sticky, plastic; continuous thick clay films on faces of peds; common very fine, fine, and medium roots; mildly alkaline; clear wavy boundary.

Btk=18 to 22 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, sticky, plastic; continuous thin clay films on faces of peds; few very fine, fine, and medium roots; strongly effervescent; carbonates disseminated and as common fine threads and soft masses; moderately alkaline; clear wavy boundary.

Bk=22 to 26 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly

Forelle (continued)

sticky, slightly plastic; violently effervescent, carbonates disseminated and as common fine threads, seams, and soft masses; moderately alkaline; clear wavy boundary.

C=26 to 60 inches; pale brown (10YR 6/3) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; strongly effervescent, carbonates disseminated; moderately alkaline.

A horizons: Hue is 2.5Y or 10YR. Reaction is neutral or mildly alkaline.

Bt horizons: Hue is 2.5Y through 7.5YR. Clay content is 28 to 35 percent. Reaction is mildly alkaline or moderately alkaline.

Bk horizons: Hue is 2.5Y or 10YR. Texture is loam, clay loam, or sandy clay loam. Reaction is moderately alkaline or strongly alkaline.

C horizons: Hue is 2.5Y or 10YR. Texture is loam, sandy loam, sandy clay loam, or clay loam. In some pedons thin strata of loamy sand occur. Reaction is mildly alkaline through strongly alkaline.

Glendive Series

The Glendive series consists of very deep, well drained soils on flood plains. These soils formed in alluvium derived dominantly from mixed sources. Slope is 0 to 3 percent. Elevation is 5,300 to 7,000 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Glendive sandy loam, 2 percent slope in an area of Havre-Forelle-Glendive complex, 0 to 3 percent slopes, about 800 feet west and 2,100 feet north of the southeast corner of section 27, T34N, R97W.

A=0 to 4 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; slightly effervescent, carbonates disseminated; mildly alkaline; abrupt smooth boundary.

C=4 to 60 inches; pale brown (10YR 6/3) sandy loam stratified with thin lenses of loamy sand, loam, and sandy clay loam, brown (10YR 5/3) moist; single grain; soft, very friable, nonsticky, nonplastic; slightly effervescent, carbonates disseminated; mildly alkaline.

The control section averages 9 to 18 percent clay.

... A horizon: Hue is 2.5Y or 10YR. Reaction is mildly alkaline or moderately alkaline.

C horizons: Texture is coarse sandy loam, sandy loam, fine sandy loam, or gravelly sandy loam stratified with thin lenses of loamy sand, loam, or sandy clay loam. Reaction is mildly alkaline through strongly alkaline.

Havre Series

The Havre series consists of very deep, well drained soils on flood plains. These soils formed in alluvium derived dominantly from mixed sources. Slope is 0 to 3 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Havre loam, 1 percent slope in an area of Havre-Absher-Forelle loams, 0 to 6 percent slopes, about 800 feet east and 2,000 feet north of the southwest corner of section 21, T33N, R98W.

A=0 to 3 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak thick platy structure parting to weak fine granular; slightly hard, very friable, nonsticky, slightly plastic; many very fine, fine, and few medium roots; slightly effervescent, carbonates disseminated; mildly alkaline; abrupt smooth boundary.

C1=3 to 14 inches; light olive brown (2.5Y 5/4) loam stratified with thin lenses of fine sandy loam, silty clay loam, and clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky, nonplastic; common very fine, fine, and few medium roots; slightly effervescent, carbonates disseminated; moderately alkaline; gradual wavy boundary.

C2=14 to 60 inches; light olive brown (2.5Y 5/4) loam stratified with thin lenses of fine sandy loam, silty clay loam, and clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine, fine, and medium roots; slightly effervescent, carbonates disseminated; moderately alkaline.

The control section is 0 to 15 percent rock fragment. The control section averages 20 to 35 percent clay.

A horizon: Hue is 2.5Y or 10YR. Reaction is mildly alkaline or moderately alkaline.

C horizons: Hue is 2.5Y or 10YR. Texture is dominantly loam or sandy clay loam, with thin strata of loamy sand, fine sandy loam, silty clay loam, or clay loam. Reaction is mildly alkaline or moderately alkaline.

Havre Variant

The Havre Variant consists of very deep and somewhat poorly drained soils in swales and seep areas. These soils formed in alluvium derived dominantly from mixed sources. Slope is 0 to 3 percent. Elevation is 5,300 to 7,000 feet. The annual precipitation is 10 to 14 inches, and the annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Havre Variant loam, 1 percent slope in an area of Havre-Havre Variant-Elkol complex, 0 to 3 percent slopes, about 2,000 feet west and 200 feet north of the southeast corner of section 4, T33N, R96W.

A=0 to 1 inch; brown (7.5YR 5/4) loam, brown (10YR 5/3) moist; weak medium granular structure; slightly hard, very friable, slightly sticky, slightly plastic; common very fine and fine roots; strongly effervescent; carbonates disseminated; strongly alkaline; abrupt smooth boundary.

C1=1 to 8 inches; very pale brown (10YR 7/4) sand, light yellowish brown (10YR 6/4) moist; common distinct medium yellowish brown (10YR 6/6) mottles; single grain; loose; common very fine and fine roots; slightly effervescent; carbonates disseminated; moderately alkaline; clear broken boundary.

C2=8 to 60 inches; brown (10YR 5/2) sandy clay loam stratified with thin lenses of sand to clay loam, dark brown (10YR 4/2) moist, common large distinct dark gray (10YR 4/1) mottles; massive; slightly hard, friable, sticky, slightly plastic; common very fine and fine roots to 14 inches; slightly effervescent, carbonates disseminated; moderately alkaline.

A fluctuating water table occurs between 1.5 to 3.5 feet from April through September.

A horizon: Reaction is moderately alkaline or strongly alkaline. The electrical conductivity is 8 to 16 mmhos/cm.

C horizon: Texture is dominantly loam or sandy clay loam stratified with thin lenses of sand, loamy sand, fine sandy loam, or clay loam. The electrical conductivity is 2 to 8 mmhos/cm.

Lupinto Series

The Lupinto series consists of very deep, well drained soils on terraces. These soils formed in alluvium derived from various sources. Slopes are 1 to 6 percent. Elevation is 7,000 to 8,300 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typical pedon of a Lupinto loam that has a slope of 1 percent, in an area of Lupinto loam, 1 to 6 percent slopes; about 2,200 feet north and 300 feet east of the southwest corner of sec. 36 T42N R106W.

A=0 to 2 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft very friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; about 5 percent gravel; moderately alkaline; abrupt smooth boundary.

Bt=2 to 9 inches; brown (7.5YR 4/4) sandy clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm slightly sticky and slightly plastic; many very fine and fine and few medium roots to a depth of 5 inches and common very fine and fine roots between depths of 5 and 9 inches; common thick clay films on faces of peds; about 15 percent gravel; few thin coatings of carbonates on pebbles; moderately alkaline; clear wavy boundary.

Bk1=9 to 23 inches; white (10YR 8/1) sandy loam, very pale brown (10YR 7/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; about 15 percent gravel; violently effervescent; disseminated carbonates and many thick coatings of carbonates on pebbles; moderately alkaline; gradual wavy boundary.

2Bk2=23 to 60 inches; white (10YR 8/1) very gravelly clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; about 45 percent gravel and 15 percent cobbles; violently effervescent; disseminated carbonates and many thick coatings of carbonates on rock fragments; strongly alkaline.

Depth to the base of the argillic horizon ranges from 8 to 10 inches. The depth of secondary accumulations of carbonates ranges from 8 to 10 inches. The average content of rack fragments in the control section ranges from 35 to 50 percent. The average content of clay ranges from 20 to 30 percent. The calcium carbonate equivalent is 15 to 35 percent in the calcic horizon.

Lupinto (continued)

The A and Bt horizons are mildly alkaline or moderately alkaline. The A horizon is 0 to 15 percent gravel. The Bt and 2Bk horizons have hue of 7.5YR or 10YR. The Bt horizon is clay loam, sandy clay loam, or gravelly sandy clay loam. It is 0 to 25 percent gravel. The 2Bk horizon is very gravelly clay loam or very gravelly sandy clay loam. It is 35 to 60 percent rock fragments. It is moderately alkaline or strongly alkaline. Some pedons have a C horizon, which is very gravelly sandy loam.

Milren Series

$I01The Milren series consists of very deep, well drained soils on fan aprons and terraces. These soils formed in alluvium derived from mixed sources. Slope is 1 to 8 percent. Elevation is 6,300 to 7,800 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Milren sandy loam, 3 percent slope, in an area of Milren-Bosler-Rock River sandy loams, 1 to 12 percent slopes, about 480 feet south and 1,300 feet east of the northwest corner of section 4, T31N, R90W.

A=0 to 2 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium granular structure; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; 10 percent gravel; neutral; abrupt smooth boundary.

E=2 to 3 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak medium platy structure parting to weak medium granular; soft, very friable, nonsticky, nonplastic; many very fine, fine, and few medium roots; 10 percent gravel; mildly alkaline; abrupt broken boundary.

Bt=3 to 11 inches; brown (7.5YR 4/4) sandy clay, brown (10YR 4/3) moist; moderate medium prismatic structure parting to strong medium subangular blocky; very hard, firm, very sticky, very plastic; common very fine and fine and few medium roots; continuous thick clay films on faces of peds; 5 percent gravel; moderately alkaline; gradual wavy boundary.

Btk=11 to 16 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky, slightly plastic; common very fine and fine and few medium roots; few thin clay films on faces of peds; strongly effervescent, carbonates disseminated and as few large threads, seams, and soft masses; moderately alkaline; clear wavy boundary.

Bk=16 to 23 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few very fine, fine, and medium roots; 2 percent gravel; violently effervescent; carbonates disseminated and as many large soft masses and in threads and seams; strongly alkaline; gradual wavy boundary.

C1=23 to 51 inches; very pale brown (10YR 7/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky, nonplastic; 2 percent gravel;

strongly effervescent, carbonates disseminated; strongly alkaline; gradual wavy boundary.

C2=51 to 56 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky, nonplastic; 2 percent gravel; slightly effervescent, carbonates disseminated; strongly alkaline; clear wavy boundary.

C3=56 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky, nonplastic; slightly effervescent, carbonates disseminated; strongly alkaline.

Depth to the base of the Bt horizon is 15 to 25 inches.

A and E horizons: Hue is 2.5Y or 10YR. The horizon has 0 to 10 percent gravel. Reaction is neutral or mildly alkaline.

Bt horizon: Hue is 10YR or 7.5YR. Texture is clay or sandy clay. The horizon is 0 to 10 percent gravel. Reaction is mildly alkaline or moderately alkaline.

Bk horizon: Hue is 2.5Y or 10YR. Texture is fine sandy loam, sandy loam, sandy clay loam, loam, or clay loam. The horizon is 0 to 15 percent gravel.

C horizons: Hue is 5Y through 10YR. Texture is fine sandy loam, loam, sandy clay loam, gravelly loam, or gravelly sandy clay loam. The horizon is 0 to 15 percent gravel. Below a depth of 40 inches, a texture of loamy fine sand may be present. Reaction is moderately alkaline or strongly alkaline.

MLRA(S): 34, 58A, 63B, 48A
REV. JFY, 7-86

PINELLI SERI

BOROLLIC HAPLARGIDS, FINE, MONTMORILLONITIC

THE PINELLI SERIES ARE WELL DRAINED SOILS FORMED IN ALLUVIUM ON ALLUVIAL FANS AND VALLEY SIDESLOPES. ELEVATION IS 2530 TO 7800 FEET. PPT IS 10 TO 14 INCHES. MAST IS ABOUT 44 F., AND THE FFS IS 83 TO 130 DAYS. TYPICALLY, THE SURFACE LAYER IS LIGHT BROWNISH-GRAY LOAM ABOUT 3 INCHES THICK. THE SUBSOIL IS ABOUT 18 INCHES THICK; THE UPPER 3 INCHES IS BROWNISH-BROWN CLAY LOAM; THE NEXT 18 INCHES IS BROWN CLAY LOAM AND THE LOWER 5 INCHES IS LIGHT BROWNISH-GRAY CLAY LOAM. THE UNDERLYING MATERIAL IS LIGHT BROWNISH GRAY CLAY LOAM TO 60 IN. OR MORE. SLOPES ARE 8 TO 45 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-3	L	CL-ML	A-4	0	75-100	75-100	65-90	50-75	25-30	5-10
0-3	CL	CL	A-6	0	75-100	75-100	70-100	60-80	30-40	10-20
0-3	SICL	CL	A-7, A-6	0	80-100	75-100	70-100	65-90	30-45	10-20
3-21	CL, SICL, C	CL, CH	A-7	0	75-100	75-100	65-90	55-85	45-55	25-35
21-60	CL, L, SICL	CL, CL-ML	A-6, A-4	0	75-100	75-100	65-90	55-85	25-35	5-15

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-3	18-27	1.15-1.25	0.6-2.0	0.16-0.18	6.6-7.8	-	LOW	.32	5	6	1-2	HIGH	LOW
0-3	28-32	1.15-1.25	0.2-0.6	0.17-0.19	6.6-7.8	-	MODERATE	.28	5	6	1-2		
0-3	27-35	1.05-1.15	0.2-0.6	0.17-0.20	6.6-7.8	-	MODERATE	.32	5	7	1-2		
3-21	35-50	1.15-1.30	0.2-0.6	0.19-0.21	6.6-8.4	-	MODERATE	.37					
21-60	18-35	1.20-1.35	0.2-0.6	0.19-0.21	7.9-9.0	<4	MODERATE	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-PERCS SLOWLY 15+%: SEVERE-PERCS SLOWLY, SLOPE
SEWAGE LAGOON AREAS	0-2%: SLIGHT 2-7%: MODERATE-SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	0-2%: GOOD 8-15%: FAIR-SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-8%: MODERATE-TOO CLAYEY 8-15%: MODERATE-TOO CLAYEY, SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SHRINK-SWELL, SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SLOPE, SHRINK-SWELL 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL, SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: MODERATE-SHRINK-SWELL, LOW STRENGTH 8-15%: MODERATE-SHRINK-SWELL, LOW STRENGTH, SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-2%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: FAIR-SHRINK-SWELL, LOW STRENGTH 15-25%: FAIR-SHRINK-SWELL, LOW STRENGTH, SLOPE 25+%: POOR-SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	0-15%: POOR-THIN LAYER 15+%: POOR-THIN LAYER, SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: SLIGHT 3-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3%: FAVORABLE 3+%: SLOPE
TERRACES AND DIVERSIONS	0-4%: ERODES EASILY 4+%: SLOPE, ERODES EASILY
GRASSED WATERWAYS	0-7%: TOO ARID, ERODES EASILY 8+%: TOO ARID, SLOPE, ERODES EASILY

EXTENSIVE INTERPRETATIONS

TANGLEY SERIES

RECREATIONAL DEVELOPMENT

CAMP AREAS	0-8% CL,SICL: SLIGHT	PLAYGROUNDS	0-2% CL,SICL: MODERATE-SMALL STONES
	8-15% CL,SICL: MODERATE-SLOPE		2-6% CL,SICL: MODERATE-SLOPE,SMALL STONES
	0-8% L: MODERATE-DUSTY		0-2% L: MODERATE-SMALL STONES,DUSTY
	8-15% L: MODERATE-SLOPE,DUSTY		2-6% L: MODERATE-SLOPE,SMALL STONES,DUSTY
	15+%: SEVERE-SLOPE		6+%: SEVERE-SLOPE
PICNIC AREAS	0-8% CL,SICL: SLIGHT	PATHS AND TRAILS	0-15% CL,SICL: SLIGHT
	8-15% CL,SICL: MODERATE-SLOPE		15-25% CL,SICL: MODERATE-SLOPE
	0-8% L: MODERATE-DUSTY		0-15% L: MODERATE-DUSTY
	8-15% L: MODERATE-SLOPE,DUSTY		15-25% L: MODERATE-SLOPE,DUSTY
	15+%: SEVERE-SLOPE		25+%: SEVERE-SLOPE

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY	WHEAT, WINTER (BU)		WHEAT, SPRING (BU)		OATS (BU)		BARLEY (BU)		ALFALFA HAY (TONS)	
		NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-8%	4E										
8-25%	6E										
25+%	7E										
0-8% WARM	3E	3E	38	—	25		45	25		1.8	
8-15% WARM	4E										
15-35% WARM	6E										
35+% WARM	7E										

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROS HAZARD	EQUIP. LIMIT	SEEDL. MORTY	WINDTH HAZARD	PLANT COMPET	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	PROD CLAS	TREES TO PLANT
							NONE			

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
0-15% WARM,DRY	LILAC	16	WESTERN SANDCHERRY	16	GREEN ASH	16	PONDEROSA PINE	
	SIBERIAN PEASHRUB	12	NANKING CHERRY	15	SIBERIAN ELM	23	BLUE SPRUCE	
	COMMON CHOKECHERRY	12	RUSSIAN-OLIVE	17	SIBERIAN CRABAPPLE	15	ROCKY MT. JUNIPER	
IRR	EASTERN REDCEDAR	22	PONDEROSA PINE	24	ROCKY MT. JUNIPER	20	GREEN ASH	
	HONEYLOCUST	39	RUSSIAN-OLIVE	25	SIBERIAN ELM	36	COMMON CHOKECHERRY	
	LILAC	10	SIBERIAN PEASHRUB	19	SILVER BUFFALOBERRY	11	TATARIAN HONEYSUCKLE	

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLIF	WOODLD WILDLIF	POTENTIAL AS HABITAT FOR: WETLAND WILDLIF	RANGE WILDL
0-8%	POOR	POOR	FAIR	-	-	FAIR	POOR	V. POOR	POOR	-	V. POOR	FAIR
8+%	POOR	POOR	FAIR	-	-	FAIR	V. POOR	V. POOR	POOR	-	V. POOR	FAIR
0-15% WARM	FAIR	GOOD	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR
15+% WARM	POOR	FAIR	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (1)

COMMON PLANT NAME	PLANT SYMBOL (MLSPM)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: COOL	CL.SICL.WARM	L.WARM	DRY
BIG SAGEBRUSH	ARTR2	10	5	5	
BLUEBUNCH WHEATGRASS	AGSP	5	5	10	
GREEN NEEDLEGRASS	STVI4	5	20	10	
NEEDLEANDTHREAD	STCO4	10		15	
NEEDLELEAF SEDGE 1/	CAEL2	5			
PLAINS REEDGRASS	CAMO	5		5	
PRAIRIE JUNEGRASS	KOCR*	5	5	5	
SANDBERG BLUEGRASS	POSE	5	5		
THICKSPIKE WHEATGRASS	AGDA	40			
WESTERN WHEATGRASS	AGSM		40	25	40
INDIAN RICEGRASS	OPHY				5
WYOMING BIG SAGEBRUSH	ARTRW*				20
BOTTLEBRUSH SQUIRRELTAIL	SIHY				5

POTENTIAL PRODUCTION (LBS./AC. DRY WT):				
FAVORABLE YEARS	1400	2400	2000	1200
NORMAL YEARS	1100	1700	1600	900
UNFAVORABLE YEARS	600	[illegible]	1100	600

FOOTNOTES

1 NOT USUALLY UTILIZED BY LIVESTOCK.
2 WARM-MT-SEA: 0-8-10-CY OF SI: COOL: MY-10-14 SE-LM: DRY = CO [illegible].

Poposhia Series

The Poposhia series consists of very deep, well drained soils on fan aprons and toe slopes. These soils formed in alluvium derived dominantly from mixed sources. Slope is 1 to 20 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 7 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Poposhia loam, 3 percent slope in an area of Forelle-Poposhia association, 2 to 12 percent slopes, about 800 feet east and 2,975 feet south of the northwest corner of section 23, T33N, R98W.

A=0 to 3 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky, slightly plastic; slightly effervescent, carbonates disseminated; moderately alkaline; abrupt smooth boundary.

Bk=3 to 15 inches; pale brown (10YR 6/3) clay loam, light olive brown (2.5Y 5/4) moist; weak medium prism-like fragments; hard, firm, sticky, plastic; common very fine and fine and few medium roots; slightly effervescent, carbonates disseminated and as few fine threads and seams; moderately alkaline; clear wavy boundary.

C=15 to 60 inches; pale brown (10YR 6/3) loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine, and medium roots to 22 inches, none below; slightly effervescent, carbonates disseminated; moderately alkaline.

The control section averages 18 to 35 percent clay and 0 to 20 percent gravel.

A horizon: Hue is 2.5Y or 10YR. Electrical conductivity is 1 to 4 mmhos/cm. Reaction is mildly alkaline to strongly alkaline.

Bk horizon: Hue is 2.5Y or 10YR. Texture is commonly loam or clay loam, but is sandy clay loam in some pedons. Reaction is mildly alkaline to strongly alkaline. Electrical conductivity is 1 to 8 mmhos/cm. This horizon is absent in some pedons.

C horizons: Hue is 2.5Y or 10YR. Texture is commonly loam, sandy clay loam, or clay loam, but in some pedons the horizons below at depth of 40 inches are stratified with lenses of loamy sand and sandy loam. Reaction is commonly moderately alkaline or strongly alkaline, but ranges to very strongly alkaline when the soil is designated as a sodic phase. Electrical conductivity is 1 to 8 mmhos/cm.

Rock River Series

The Rock River series consists of very deep, well drained soils on fan aprons,toe slopes, and terraces. These soils formed in alluvium derived from mixed sources. Slope is 1 to 12 percent. Elevation is 5,300 to 7,500 feet. Annual precipitation is 10 to 14 inches, and annual air temperature is 39 to 45 degrees F. The frost-free period is 90 to 110 days.

Typical pedon of Rock River fine sandy loam, 4 percent slope in an area of Cushool-Rock River association, 1 to 15 percent slopes, about 3,000 feet east and 50 feet south of the northwest corner of section 31, T34N, R95W.

A=0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak medium platy structure parting to weak fine granular; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; many very fine and fine vesicular pores; mildly alkaline; abrupt smooth boundary.

Bt=3 to 13 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky, plastic; continuous thick clay films on faces of peds; common very fine and fine and few medium roots; mildly alkaline; clear wavy boundary.

Btk=13 to 18 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky, plastic; continuous thin and few thick clay films on faces of peds; few very fine, fine, and medium roots; strongly effervescent, carbonates disseminated and as many large soft masses and seams; moderately alkaline; clear wavy boundary.

Bk=18 to 34 inches; pale brown (10YR 6/3) sandy clay loam, grayish brown (10YR 5/2) moist; moderate medium prismatic structure; hard, friable, sticky, plastic; few very fine, fine, and medium roots to 22 inches; strongly effervescent, carbonates disseminated and as many large soft masses and seams; moderately alkaline; clear wavy boundary.

C=34 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; hard, friable, sticky, plastic; slightly effervescent, carbonates disseminated; moderately alkaline.

The control section averages 20 to 35 percent clay.

A horizon: Hue is 10YR or 7.5YR. Reaction is mildly alkaline or moderately alkaline.

Rock River (continued)

Bt horizons: Hue is 10YR or 7.5YR. Reaction is mildly alkaline or moderately alkaline.

Bk horizons: Hue is 10YR or 7.5YR. Texture is sandy loam, fine sandy loam, sandy clay loam, or gravelly sandy loam. The horizon is 0 to 25 percent gravel. Reaction is moderately alkaline or strongly alkaline.

C horizons: Hue is 2.5Y through 7.5YR. Texture is sandy loam, fine sandy loam, or sandy clay loam. Reaction is moderately alkaline or strongly alkaline.

Sinkson Series

The Sinkson series consists of very deep, well drained soils on fan aprons. These soils formed in alluvium derived dominantly from red sandstone and siltstone. Slopes are 0 to 20 percent. Elevation is 5,500 to 8,000 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typical pedon of a Sinkson loam that has a slope of 6 percent, in an area of Thermopolis-Sinkson association, hilly; about 2,500 feet east and 3,500 feet north of the southwest corner of sec. 11, T40N R91W.

A=0 to 3 inches; yellowish red (5YR 4/6) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic, common very fine and fine roots; slightly effervescent; disseminated carbonates; moderately alkaline; abrupt wavy boundary.

Bky=3 to 14 inches; yellowish red (5YR 5/6) loam, red (2.5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; strongly effervescent; disseminated carbonates and few fine soft masses of carbonates; few fine soft masses of gypsum; moderately alkaline; clear wavy boundary.

C=14 to 60 inches; yellowish red (5YR 5/6) silt loam, red (2.5YR 4/6) moist; massive; soft very friable, slightly sticky and slightly plastic; few very fine and fine roots to a depth of 20 inches and no roots below that depth; strongly effervescent; disseminated carbonates; moderately alkaline.

The control section ranges from 0 to 10 percent rock fragments. It is 18 to 30 percent clay and more than 15 percent fine sand or coarser sand. The A horizon has hue of 7.5YR or 5YR. The B and C horizons are sandy clay loam, loam, or silt loam, Some pedons do not have a B horizon.

SOIL INTERPRETATIONS RECORD

MLRA(S): 48A, 51, 48B.
REV. RD: 1-85 — STUNNER SERI
BOROLLIC HAPLARGIDS, FINE-LOAMY, MIXED

THE STUNNER SERIES CONSISTS OF DEEP, WELL-DRAINED SOILS DEVELOPING IN ALLUVIUM ON FANS, TERRACES AND VALLEY SIDESLOPES THE SURFACE LAYER IS A LOAM, ABOUT 7 INCHES THICK. THE SUBSOIL IS CLAY LOAM, ABOUT 18 INCHES THICK. THE UNDERLYING LAY DAM THAT EXTENDS TO 60 INCHES OR MORE. NATURAL VEGETATION INCLUDES GRASSES AND LOW SHRUBS. ANNUAL PRECIPITATION 7 INCHES. FROST-FREE SEASON IS ABOUT 90 TO 180 DAYS. SLOPES ARE 0 TO 50 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-7	L	ML, CL-ML	A-4	0-10	90-100	80-100	70-90	50-75	20-30	NP-10
0-7	CB-L, CBV-L	ML, CL-ML	A-4	10-35	75-100	75-95	70-90	50-75	20-30	NP-10
7-25	CL, L	CL	A-6	0-5	90-100	85-100	75-100	60-80	25-35	10-20
25-60	L, GR-L	ML, SM-SC, CL-ML, SM	A-4	0-10	75-100	65-100	65-95	45-75	20-30	NP-10

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-7	10-20	1.20-1.30	0.6-2.0	0.16-0.18	6.6-7.3	-	LOW	.24	5	5	1-3	HIGH	LOW
0-7	10-20	1.25-1.35	0.6-2.0	0.14-0.16	6.6-7.3	-	LOW	.28	5	6	1-3		
7-25	20-35	1.25-1.35	0.2-0.6	0.17-0.20	6.6-8.4	<4	MODERATE	.28					
25-60	10-20	1.30-1.40	0.6-2.0	0.14-0.16	7.9-8.4	<2	LOW	.28					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	SEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	IRR?	POTENTIAL FROST ACTION
NONE			>4.0			-		>60		-		3	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-PERCS SLOWLY 15+%: SEVERE-PERCS SLOWLY,SLOPE
SEWAGE LAGOON AREAS	0-2%: MODERATE-SEEPAGE 2-7%: MODERATE-SEEPAGE,SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	0-8%: FAIR-SMALL STONES 8-15%: FAIR-SMALL STONES,SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SHRINK-SWELL,SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL,SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: MODERATE-SHRINK-SWELL,LOW STRENGTH 8-15%: MODERATE-SHRINK-SWELL,LOW STRENGTH, SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8% L: MODERATE-LARGE STONES 8-15% L: MODERATE-LARGE STONES,SLOPE 15+% L: SEVERE-SLOPE 0-15% CB,CBV: SEVERE-LARGE STONES 15+% CB,CBV: SEVERE-LARGE STONES,SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-25%: FAIR-SLOPE 25+%: POOR-SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	0-15%: POOR-SMALL STONES 15+%: POOR-SMALL STONES,SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: MODERATE-SEEPAGE 3-8%: MODERATE-SEEPAGE,SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3%: FAVORABLE 3+%: SLOPE
TERRACES AND DIVERSIONS	0-4%: FAVORABLE 8+%: SLOPE
GRASSED WATERWAYS	0-3%: TOO ARID 8+%: TOO ARID,SLOPE

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT

CAMP AREAS	0-8%: MODERATE-DUSTY 8-15%: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PLAYGROUNDS	0-2% L: MODERATE-SMALL STONES 2-6% L: MODERATE-SLOPE,SMALL STONES 6+% L: SEVERE-SLOPE 0-6% CB,CBV: SEVERE-LARGE STONES 6+% CB,CBV: SEVERE-LARGE STONES,SLOPE
PICNIC AREAS	0-4%: MODERATE-DUSTY 8-15%: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PATHS AND TRAILS	0-15% L: MODERATE-DUSTY 15-25% L: MODERATE-SLOPE,DUSTY 0-15% CB,CBV: MODERATE-LARGE STONES,DUST 15+25% CB,CBV: MODERATE-LARGE STONES,SLOPE 25+%: SEVERE-SLOPE

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT) (C)

CLASS-DETERMINING PHASE	CAPABILITY		ALFALFA HAY (TONS)		POTATOES, IRISH (CWT)		BARLEY (BU)		OATS (BU)		LETTUCE (CRATES)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1% L	7C	3C		3.0		250		78		80		480		
1-3% L	7E	3E		3.0		250		73		88		480		
3-12% L	7E	4E		2.5		-		58		70		-		
12+% L	7E	6E												
0-50% CB	7E	-												
0-50% CBV	7S													

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDL. MORTAL	WINDTH HAZARD	PLANT COMPET	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	PROD CLAS	TREES TO PLANT
							NONE			

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	POTENTIAL AS HABITAT FOR: WETLAND WILDLF	RANGEL WILDLF
NIRR	V. POOR	V. POOR	FAIR	-	-	FAIR	V. POOR	V. POOR	V. POOR	-	V. POOR	FAIR
IRR	FAIR	FAIR	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (TLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: DRY	POIST			
WINTERFAT	ELLAS	35	-			
BOTTLEBRUSH SQUIRRELTAIL	SIHY	15	18			
BLUE GRAMA	BOGR2	15	-			
INDIAN RICEGRASS	ORHY	10	5			
WESTERN WHEATGRASS	AGSM	5	15			
RABBITBRUSH	CHRYS9	5	-			
BASIN BIG SAGEBRUSH	ARTR2		15			
NEEDLEANDTHREAD	STCO4		5			
BLUEBUNCH WHEATGRASS	AGSP		38			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		900	800			
NORMAL YEARS		600	500			
UNFAVORABLE YEARS		400	400			

FOOTNOTES

1 RATE SLIGHT IF ABSORPTION FIELD PLACED IN UNDERLYING MATERIALS.

Thermopolis Series

The Thermopolis series consists of very shallow or shallow, well drained soils on hills and ridges. These soils formed in residuum and slope alluvium derived dominantly from sandstone and siltstone. Slopes are 10 to 30 percent. Elevation is 5,500 to 7,800 feet. The annual precipitation is 10 to 14 inches, the average annual air temperature is 39 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typical pedon of a Thermopolis loam that has a slope of 8 percent, in an area of Sinkson-Almy-Thermopolis association, rolling; about 3,200 feet north and 1,900 feet east of the southwest corner of sec. 11, T40N R91W.

A=0 to 3 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; strongly effervescent; disseminated carbonates; moderately alkaline; abrupt smooth boundary.

C=3 to 16 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) most; weak fine and medium subangular blocky structure; soft, very friable, slightly plastic, few fine and medium roots; strongly effervescent; disseminated carbonates; moderately alkaline; abrupt wavy boundary.

Cr=16 inches; soft siltstone.

The depth to bedrock ranges from 6 to 20 inches. The control section is 0 to 15 percent channery fragments. The A horizon has hue of 7.5YR to 2.5YR. It is mildly alkaline or moderately alkaline. The C horizon has hue of 5YR or 2.5YR. It is loam or silt loam.

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D-01

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