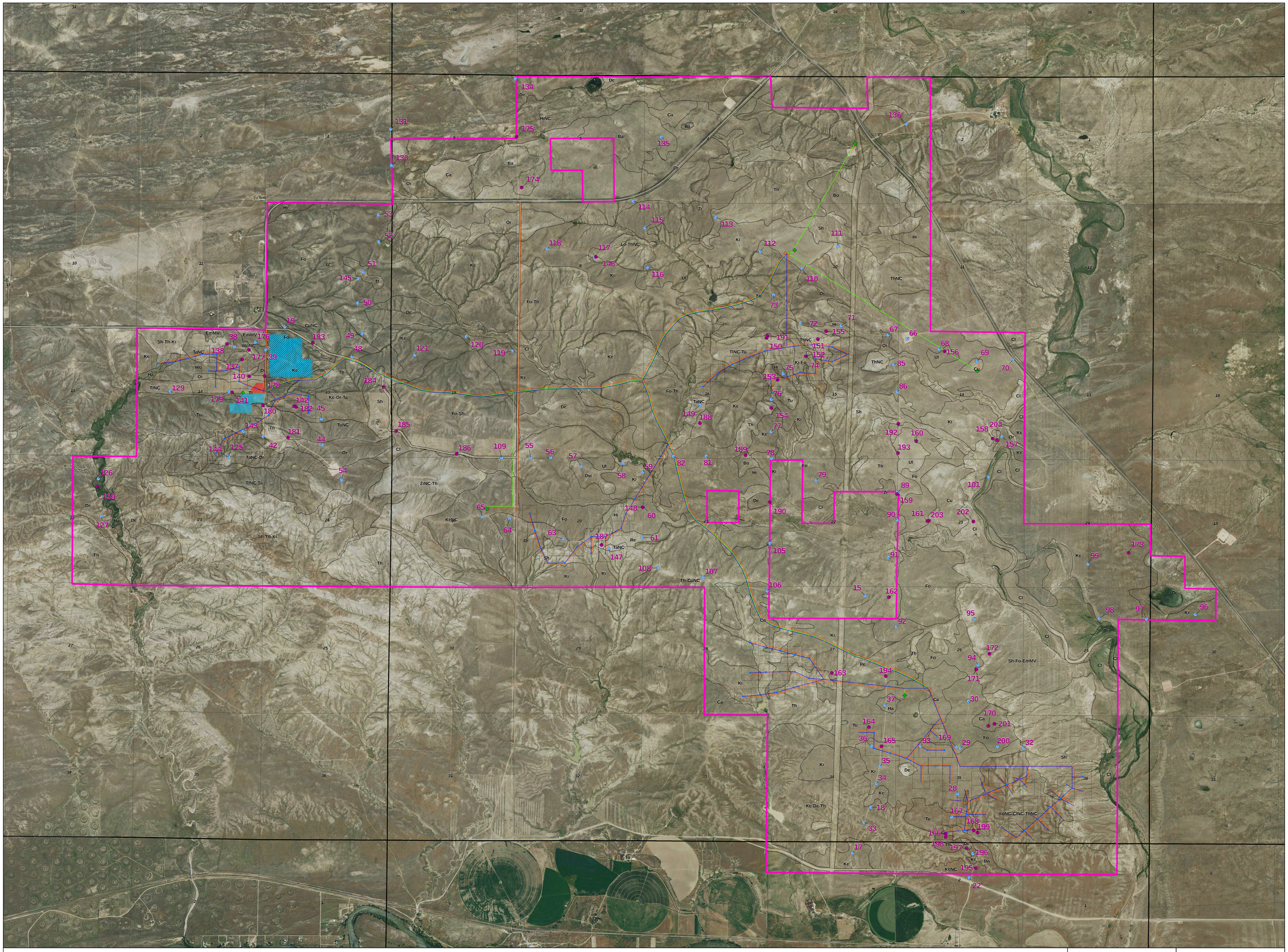
ADDENDUM 3.3-A
SOILS MAP



LEGEND

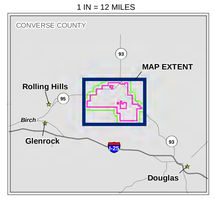
- Soil Samples with Lab Analysis
- Soil Verification Points
- Deep Disposal Well
- Header House
- Booster Station
- Trunkline
- Deep Disposal Well Pipeline
- Primary Access
- Secondary Access Road
- Soil Map Units
- Permit Boundary
- Fenced Area
- Plant Facility Site Area
- Permeate Pond Area
- Well Pattern
- Evaporation Ponds
- Monitor Well Ring
- Wellfield

SOILS MAP UNITS TABLE

Map Symbol	Soil Map Unit	Acres In Permit Boundary
Ba	Bahl clay loam	263.13
Bo	Bowbac sandy loam	165.98
Ca	Cambria loam	513.05
Cl	Clarkelen fine sandy loam	1099.27
Cu	Cushman very fine sandy loam	110.08
CuNC	Cushman noncalcareous variant	111.81
D	Previously Disturbed	322.79
De	Decolney fine sandy loam	672.78
Dr	Drakinab loamy sand	10.33
Dw	Dwyer fine sand	66.49
EmMV	Embry deep variant	23.16
Fo	Forkwood loam	1590.50
FoNC-CINC-ThNC	Forkwood noncalcareous variant-Clarkelen noncalcareous variant-Theedle noncalcareous variant Complex	400.40
Fo-Sh	Forkwood-Shingle Complex	407.21
Fo-Th	Forkwood-Theedle Complex	663.04
Ha	Haverdad loam	81.61
Hi	Hiland fine sandy loam	855.17
HiNC	Hiland noncalcareous variant	253.73
Ke	Keeline sandy loam	1356.81
Ke-De-Th	Keeline-Decolney-Theedle Complex	544.48
Ke	Keeline less calcareous variant	4.74
KeNC	Keeline noncalcareous variant	219.64
Ke-Or-Ta	Keeline-Orpha-Taluce Complex	187.72
Ke	Keeline variant	25.12
Ki	Kishona loam	1587.18
Ki-Fo	Kishona-Forkwood Complex	34.14
Ki	Kishona less calcareous variant	4.30
Lo-ThNC	Lolite-Theedle noncalcareous Complex	61.34
Or	Orpha loamy sand	723.34
Or	Orpha moderately deep variant	101.55
Pe	Petrie clay loam	108.39
Re	Renohill clay loam	29.72
Sh	Shingle clay loam	967.92
Sh-Fo-EmMV	Shingle-Forkwood-Embry moderately deep variant Complex	354.73
ShNC	Shingle noncalcareous variant	8.17
Sh-Th-Ki	Shingle-Theedle-Kishona Complex	702.81
TaNC	Taluce noncalcareous variant	84.83
TaNC-Or	Taluce noncalcareous variant-Orpha moderately deep variant Complex	92.79
Th	Theedle loam	1265.54
Th-CuNC	Theedle-Cushman noncalcareous variant Complex	345.07
ThNC	Theedle noncalcareous variant	213.47
Tl	Tullock loamy sand	91.52
TlNC	Tullock noncalcareous variant	26.45
TlNC-Ta	Tullock noncalcareous variant-Taluce Complex	375.03
TlNC-Tu	Tullock noncalcareous variant-Turnercrest Complex	111.57
Tu	Turnercrest fine sandy loam	491.66
TuNC	Turnercrest noncalcareous variant	74.44
Ul	Ulm clay loam	517.63

GENERAL LOCATION MAP

1 IN = 12 MILES



0 750 1,500 3,000
FEET
1 INCH = 1,500 FEET

DRAFTED BY:	DATE:
T. SPELTS	11/18/2009
COMPLETENESS REVIEW:	DATE:
T. SPELTS	5/4/2016
TECHNICAL REVIEW:	DATE:
C. ADAMS	5/4/2016

MAP PROJECTION: NAD 1983, UTM Z13N, M

IMAGE TYPE/YEAR: NAIP ORTHO 2015

FILE: Ludeman_Soils_v15_02242016

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LUDEMAN PROJECT

BASELINE SOIL ASSESSMENT

CONVERSE COUNTY, WY

BRS Environmental Associates, Inc.

MAP # 1 OF 1

ADDENDUM 3.3-B
SOILS TABLES

TABLE OF CONTENTS

Table 3.3B- 1: Soil Mapping Unit Acreages

Map Symbol	Map Unit Description	Proposed Disturbance	Existing Disturbance	Proposed Disturbance Within Existing Disturbance	Total Disturbance
Ba	Bahl clay loam	0.00	0.05	0.00	0.05
Bo	Bowbac sandy loam	0.00	16.03	0.00	16.03
Ca	Cambria loam	10.12	23.15	0.00	33.27
Cl	Clarkelen fine sandy loam	0.00	48.20	0.00	48.20
CuNC	Cushman noncalcareous variant	0.00	4.18	0.00	4.18
Cu	Cushman very fine sandy loam	0.26	0.00	0.00	0.26
De	Decolney fine sandy loam	1.87	4.39	0.00	6.26
Dr	Draknab loamy sand	0.00	0.00	0.00	0.00
Dw	Dwyer fine sand	2.37	0.00	0.00	2.37
EmMV	Embry moderately deep variant	0.14	2.60	0.00	2.74
Fo	Forkwood loam	21.87	21.12	0.35	43.34
FoNC-ClNC-ThNC	Forkwood noncalcareous variant-Clarkelen noncalcareous variant-Theedle noncalcareous variant	104.09	0.00	0.00	104.09
Fo-Sh	Forkwood-Shingle complex	0.00	12.12	0.00	12.12
Fo-Th	Forkwood-Theedle complex	15.05	5.63	0.00	20.68
Ha	Haverdad loam	8.05	0.00	0.00	8.05
Hi	Hiland fine sandy loam	67.50	34.87	2.55	104.92
HiNC	Hiland noncalcareous variant	0.00	0.00	0.00	0.00
KeNC	Keeline noncalcareous variant	0.00	11.90	0.00	11.90
Ke	Keeline sandy loam	8.26	29.16	0.01	37.43
Ke-De-Th	Keeline-Decolney-Theedle complex	0.22	31.93	0.01	32.16
Ke-Or-Ta	Keeline-Orpha-Taluce complex	19.05	1.46	0.00	20.51

Map Symbol	Map Unit Description	Proposed Disturbance	Existing Disturbance	Proposed Disturbance Within Existing Disturbance	Total Disturbance
Ki	Kishona loam	160.54	60.69	0.03	221.26
Ki-Fo	Kishona-Forkwood complex	18.45	0.00	0.00	18.45
Lo-ThNC	Lolite-Theedle noncalcareous complex	0.00	0.00	0.00	0.00
Or	Orpha loamy sand	20.73	24.73	0.00	45.46
OrMV	Orpha moderately deep variant	0.00	4.68	0.00	4.68
Pe	Petrie clay loam	1.07	2.41	0.00	3.48
Re	Renohill clay loam	7.77	0.00	0.00	7.77
Sh	Shingle clay loam	80.08	25.33	0.00	105.41
ShNC	Shingle noncalcareous variant	1.42	0.00	0.00	1.42
Sh-Fo-EmMV	Shingle-Forkwood-Embry moderately deep variant complex	0.00	0.00	0.00	0.00
Sh-Th-Ki	Shingle-Theedle-Kishona complex	7.16	3.30	0.00	10.46
TaNC	Taluce noncalcareous variant	25.64	0.60	0.00	26.24
TaNC-Or	Taluce noncalcareous variant-Orpha complex	16.45	0.00	0.00	16.45
Th	Theedle loam	66.90	6.68	0.00	73.58
ThNC	Theedle noncalcareous variant	19.78	3.39	0.00	23.17
Th-CuNC	Theedle-Cushman noncalcareous variant complex	1.25	0.00	0.00	1.25
Tl	Tullock loamy sand	17.82	0.00	0.00	17.82
TlNC	Tullock noncalcareous variant	0.00	0.00	0.00	0.00
TlNC-Ta	Tullock noncalcareous variant-Taluce complex	0.00	0.00	0.00	0.00
TlNC-Tu	Tullock noncalcareous variant-Turnercrest complex	27.74	0.00	0.00	27.74

Map Symbol	Map Unit Description	Proposed Disturbance	Existing Disturbance	Proposed Disturbance Within Existing Disturbance	Total Disturbance
Tu	Turnercrest fine sandy loam	45.03	9.06	0.04	54.13
TuNC	Turnercrest noncalcareous variant	0.15	0.00	0.00	0.15
Ul	Ulm clay loam	1.22	2.55	0.00	3.77
Wo	Worf loam	34.28	0.00	0.00	34.28
WoNC	Worf noncalcareous variant	0.08	0.00	0.00	0.08
Zi	Zigweid loam	1.06	0.00	0.00	1.06
ZiNC-Th	Zigweid noncalcareous variant-Theedle complex	0.00	0.02	0.00	0.02
Total		**813.47**	**390.24**	**2.99**	**1,206.70**

Table 3.3B- 2: Soil Series Sample Summary

Soil Series	Number of Profiles Sampled for Chemical Analysis 1
Bahl	1
Bowbac	1
Cambria	2
Clarkelen	3
Clarkelen noncalcareous variant	1
Cushman	1
Cushman noncalcareous variant	1
Decolney	2
Draknab	1
Dwyer	1
Embry moderately deep variant	1
Forkwood	3
Forkwood noncalcareous variant	1
Haverdad	1
Hiland	2
Hiland noncalcareous variant	1
Keeline	3
Keeline noncalcareous variant	1
Kishona	3
Lolite	1
Orpha	2
Petrie	1
Renohill	1
Shingle	3
Shingle noncalcareous variant	1
Taluce	1
Taluce noncalcareous variant	1
Theedle	3
Theedle noncalcareous variant	1
Tullock	1
Tullock noncalcareous variant	1
Turnercrest	2
Turnercrest noncalcareous variant	1
Ulm	2
Worf	1
Worf noncalcareous variant	1
Zigweid	1
Zigweid noncalcareous variant	1
Total	**56**

[1]Samples were taken within proposed disturbed area, when possible, as defined by initial estimates of the ore body

Table 3.3B- 3: Soil Sample Locations

Soil Sample Number[1]	Map Unit Symbol	Soil Series
137	Wo	Worf clay loam
138	TaNC	Taluce noncalcareous variant
139	Ha	Haverdad clay loam
140	Or	Orpha sandy clay loam
141	Tl	Tullock sandy clay loam
142	Ke-Or-Ta	Taluce sandy loam
146	Lo-ThNC	Lolite clay
148	Hi	Hiland sandy clay loam
150	TlNC-Tu	Turnercrest sandy loam
151	ThNC	Theedle noncalcareous variant
152	Ki-Fo	Forkwood sandy clay loam
153	Ke	Keeline sandy loam
154	Th	Theedle sandy clay loam
155	Hi	Hiland sandy clay loam
156	Ul	Ulm sandy clay loam
158	Ki	Kishona clay
159	Zi	Zigweid clay
160	Fo	Forkwood clay loam
161	Fo	Forkwood clay loam
162	ShNC	Shingle noncalcareous variant
163	Ki	Kishona clay/clay loam
164	Tu	Turnercrest sandy clay loam
165	Ki	Kishona clay loam
166	Dw	Dwyer loamy sand
168	FoNC-ClNC-ThNC	Clarkelen noncalcareous variant
170	Ca	Cambria sandy clay loam
171	Sh-Fo-EmMV	Shingle clay loam
172	Sh-Fo-EmMV	Embry moderately deep variant
173	Ke	Keeline sandy clay loam
174	Ba	Bahl clay loam
175	HiNC	Hiland noncalcareous variant
177	WoNC	Worf noncalcareous variant
178	Dr	Draknab sandy loam
180	Th	Theedle clay
181	TuNC	Turnercrest noncalcareous variant
182	Ke-Or-Ta	Orpha sandy loam

Soil Sample Number[1]	Map Unit Symbol	Soil Series
183	CuNC	Cushman noncalcareous variant
184	Sh	Shingle sandy loam/sandy clay loam
185	Cl	Clarkelen sandy loam
186	ZiNC-Th	Zigweid noncalcareous variant
187	Re	Renohill clay
188	Ke	Keeline sandy loam/sandy clay loam
189	Bo	Bowbac sandy clay
190	De	Decolney sandy loam
191	TlNC-Tu	Tullock noncalcareous variant
192	Sh	Shingle clay loam
193	Ul	Ulm clay loam
194	Pe	Petrie clay/clay loam
195	KeNC	Keeline noncalcareous variant
197	De	Decolney sandy loam
198	Th	Theedle sandy loam
199	FoNC-ClNC-ThNC	Forkwood noncalcareous variant
201	Ca	Cambria sandy loam/sandy clay loam
202	Cl	Clarkelen clay
203	Cu	Cushman clay loam
204	Cl	Clarkelen sandy clay loam

[1]Samples were taken within proposed disturbed area, when possible, as defined by initial estimates of the ore body

Table 3.3B- 4: Summary of Marginal and Unsuitable Parameters within Sampled Profiles

Series	Sample Point	Depth (in)	Marginal[1]	Unsuitable[1]
Worf	137	5-12	Clay %	
Haverdad	139	36-46	Saturation % Clay %	
Orpha	140	35-45	Clay %	
		45-55	Saturation % Clay %	
		55-60	Clay %	
Tullock	141	0-11	Saturation %	
Taluce	142	8-16	Saturation %	
Lolite	146	0-9	Clay %	
		9-24	Clay %	
Turnercrest	150	20-35	Saturation %	
Theedle noncalcareous variant	151	7-24	Clay %	
Theedle	154	24-36	Clay %	
Hiland	155	37-48	pH	
Ulm	156	12-29	Clay %	
		29-37	Clay % Selenium	
		37-53	Clay %	
Kishona	158	0-12	Clay %	
Zigweid	159	0-14	Clay %	
		14-28	Clay %	
Forkwood	160	13-21	Clay %	
		33-55	Clay %	
		55-60	Clay %	
Forkwood	161	12-28	Clay %	
		28-46	Clay %	
Shingle noncalcareous variant	162	0-12	Clay %	
Kishona	163	0-7	Clay %	
		20-29	SAR	
		29-37	SAR	EC
		37-50		EC SAR
		50-60		EC SAR
Dwyer	166	0-7	Saturation %	
		21-36	Saturation %	
		36-48	Saturation %	
Embry moderately deep variant	172	0-12	Saturation %	
		12-19	Saturation %	
Bahl	174	3-10	Clay %	

Series	Sample Point	Depth (in)	Marginal[1]	Unsuitable[1]
		10-20	Clay %	
		20-36	Clay %	
		36-48	Selenium	
Hiland noncalcareous variant	175	0-4	Saturation % Sand % Selenium	
Draknab	178	2-12	Saturation %	
		12-18	Saturation %	
		29-35	Saturation %	
		35-60	Saturation %	
Theedle	180	0-2	Clay %	
		2-12	Clay %	
Clarkelen	185	31-48	Saturation %	
Renohill	187	0-8	Clay %	
		8-17	Clay %	
		17-22	Clay %	
Keeline	188	21-30		SAR
Bowbac	189	0-8		SAR
		18-24		SAR
Decolney	190	0-3	SAR	
Tullock noncalcareous variant	191	3-11	Saturation %	
Shingle	192	1-8	Clay %	
Ulm	193	3-10	Clay %	
		36-60	Clay % Selenium	
Petrie	194	0-8	Clay %	
		32-44	Clay %	
Keeline noncalcareous variant	195	0-9	Saturation %	
		9-18	Saturation %	
		18-37	Saturation %	
		37-48	Saturation %	
Decolney	197	0-4	Saturation %	
		4-10	Saturation %	
		10-19	Saturation %	
		19-36	Saturation %	
		36-48	Saturation % Sand %	
Theedle	198	0-6	Saturation %	
		6-22	Saturation %	
Forkwood noncalcareous variant	199	14-26	Saturation %	
		43-60	Saturation %	
Clarkelen	202	0-4	Clay %	
		4-17	Clay %	

Series	Sample Point	Depth (in)	Marginal[1]	Unsuitable[1]
Cushman	203	8-21	Clay %	
		21-40	Selenium	
Clarkelen	204	29-48	Saturation %	

[1]Marginal and unsuitable parameters based on lab analysis

Table 3.3B- 5: Summary of Trends in Marginal and Unsuitable Parameters for Soil Series

Series	Unsuitable/Marginal Parameter[1]
Bahl	Clay %
Bowbac	SAR
Clarkelen	Saturation %
Cushman	Clay %, Selenium
Decolney	Saturation %
Draknab	Saturation %
Dwyer	Saturation %
Embry moderately deep variant	Saturation %
Forkwood	Clay %
Forkwood noncalcareous variant	Saturation %
Haverdad	Saturation %, Clay %
Hiland	pH
Hiland noncalcareous variant	Saturation %, Sand %, Selenium
Keeline	SAR
Keeline noncalcareous variant	Saturation %
Kishona	Clay %, EC, SAR
Lolite	Clay %
Orpha	Saturation %
Petrie	Clay %
Renohill	Clay %
Shingle	Clay %
Shingle noncalcareous variant	Clay %
Taluce	Saturation %
Theedle	Clay %
Theedle noncalcareous variant	Clay %
Tullock	Saturation %
Tullock noncalcareous variant	Saturation %
Ulm	Clay %, Selenium
Worf	Clay %
Zigweid	Clay %

[1]Marginal and unsuitable parameters based on lab analysis

Table 3.3B- 6: Summary of Approximate Soil Salvage Depths

Map Symbol	Mapping Unit Description	Disturbance Areas1 (acres)	Salvage Depth (feet)	Total Volume (Acre feet)
Ba	Bahl clay loam	0.05	0.83	0.04
Bo	Bowbac sandy loam	16.03	0.00	0.00
Ca	Cambria loam	33.27	2.88	95.82
Cl	Clarkelen fine sandy loam	48.20	2.89	139.30
CuNC	Cushman noncalcareous variant	4.18	1.83	7.65
Cu	Cushman very fine sandy loam	0.26	0.67	0.17
De	Decolney fine sandy loam	6.26	2.08	13.02
Dw	Dwyer fine sand	2.37	4.00	9.48
EmMV	Embry moderately deep variant	2.74	1.58	4.33
Fo	Forkwood loam	43.34	1.78	77.15
FoNC-ClNC-ThNC	Forkwood noncalcareous variant-Clarkelen noncalcareous variant-Theedle noncalcareous variant	104.09	3.53	367.44
Fo-Sh	Forkwood-Shingle complex	12.12	1.33	16.16
Fo-Th	Forkwood-Theedle complex	20.68	1.88	38.88
Ha	Haverdad loam	8.05	1.67	13.44
Hi	Hiland fine sandy loam	104.92	1.50	157.38
KeNC	Keeline noncalcareous variant	11.90	4.00	47.60
Ke	Keeline sandy loam	37.43	2.69	100.69
Ke-De-Th	Keeline-Decolney-Theedle complex	32.16	2.25	72.36
Ke-Or-Ta	Keeline-Orpha-Taluce complex	20.51	2.33	47.79
Ki	Kishona loam	221.26	3.14	694.76
Ki-Fo	Kishona-Forkwood complex	18.45	2.46	45.39
Or	Orpha loamy sand	45.46	3.63	165.02
OrMV	Orpha moderately deep variant	4.68	2.92	13.67
Pe	Petrie clay loam	3.48	3.00	10.44
Re	Renohill clay loam	7.77	1.42	11.03
Sh	Shingle clay loam	105.41	0.89	93.81
ShNC	Shingle noncalcareous variant	1.42	1.00	1.42
Sh-Th-Ki	Shingle-Theedle-Kishona complex	10.46	2.00	20.92
TaNC	Taluce noncalcareous variant	26.24	1.25	32.80
TaNC-Or	Taluce noncalcareous variant-Orpha complex	16.45	2.44	40.14
Th	Theedle loam	73.58	1.98	145.69
ThNC	Theedle noncalcareous variant	23.17	0.58	13.44
Th-CuNC	Theedle-Cushman noncalcareous variant complex	1.25	1.90	2.38
Tl	Tullock loamy sand	17.82	1.25	22.28

Map Symbol	Mapping Unit Description	Disturbance Areas1 (acres)	Salvage Depth (feet)	Total Volume (Acre feet)
TlNC-Tu	Tullock noncalcareous variant-Turnercrest complex	27.74	1.96	54.37
Tu	Turnercrest fine sandy loam	54.13	2.42	130.99
TuNC	Turnercrest noncalcareous variant	0.15	1.75	0.26
Ul	Ulm clay loam	3.77	2.71	10.22
Wo	Worf loam	34.28	1.58	54.16
WoNC	Worf noncalcareous variant	0.08	1.00	0.08
Zi	Zigweid loam	1.06	5.00	5.3
ZiNC-Th	Zigweid noncalcareous variant-Theedle complex	0.02	3.49	0.07
Average Salvage Depth of Permit/Project Area		**---**	**2.13**	**---**
Total		**1,206.70**	**---**	**2,777.34**

[1]Samples were taken within proposed disturbed area, when possible, as defined by initial estimates of the ore body

Table 3.3B- 7: Summary of Wind and Water Erosion Hazards

Soil Sample Number	Soil Series	Water Erosion Hazard[1]	Wind Erosion Hazard[2]
137	Worf clay loam	Slight	Very Slight
138	Taluce noncalcareous variant	Negligible	Moderate
139	Haverdad clay loam	Slight	Slight
140	Orpha sandy clay loam	Very Slight	Moderate
141	Tullock sandy clay loam	Negligible	Moderate
142	Taluce sandy loam	Negligible	Severe
146	Lolite clay	Very Slight	Very Slight
148	Hiland sandy clay loam	Very Slight	Slight
150	Turnercrest sandy loam	Negligible	Severe
151	Theedle noncalcareous variant	Very Slight	Very Slight
152	Forkwood sandy clay loam	Very Slight	Slight
153	Keeline sandy loam	Negligible	Moderate
154	Theedle sandy clay loam	Very Slight	Slight
155	Hiland sandy clay loam	Very Slight	Slight
156	Ulm sandy clay loam	Very Slight	Slight
158	Kishona clay	Very Slight	Very Slight
159	Zigweid clay	Very Slight	Very Slight
160	Forkwood clay loam	Slight	Very Slight
161	Forkwood clay loam	Very Slight	Slight
162	Shingle noncalcareous variant	Slight	Very Slight
163	Kishona clay/clay loam	Slight	Very Slight
164	Turnercrest sandy clay loam	Very Slight	Slight
165	Kishona clay loam	Very Slight	Slight
166	Dwyer loamy sand	Negligible	Severe
168	Clarkelen noncalcareous variant	Very Slight	Moderate
170	Cambria sandy clay loam	Negligible	Moderate
171	Shingle clay loam	Slight	Very Slight
172	Embry moderately deep variant	Very Slight	Moderate
173	Keeline sandy clay loam	Very Slight	Moderate
174	Bahl clay loam	Slight	Very Slight
175	Hiland noncalcareous variant	Negligible	Severe
177	Worf noncalcareous variant	Very Slight	Slight
178	Draknab sandy loam	Very Slight	Moderate
180	Theedle clay	Slight	Very Slight

Soil Sample Number	Soil Series	Water Erosion Hazard[1]	Wind Erosion Hazard[2]
181	Turnercrest noncalcareous variant	Negligible	Moderate
182	Orpha sandy loam	Negligible	Severe
183	Cushman noncalcareous variant	Slight	Very Slight
184	Shingle sandy loam/sandy clay loam	Very Slight	Slight
185	Clarkelen sandy loam	Very Slight	Moderate
186	Zigweid noncalcareous variant	Slight	Very Slight
187	Renohill clay	Slight	Negligible
188	Keeline sandy loam/sandy clay loam	Very Slight	Moderate
189	Bowbac sandy clay	Negligible	Slight
190	Decolney sandy loam	Very Slight	Moderate
191	Tullock noncalcareous variant	Negligible	Moderate
192	Shingle clay loam	Very Slight	Very Slight
193	Ulm clay loam	Very Slight	Very Slight
194	Petrie clay/clay loam	Very Slight	Very Slight
195	Keeline noncalcareous variant	Very Slight	Moderate
197	Decolney sandy loam	Very Slight	Moderate
198	Theedle sandy loam	Very Slight	Moderate
199	Forkwood noncalcareous variant	Very Slight	Slight
201	Cambria sandy loam/sandy clay loam	Very Slight	Moderate
202	Clarkelen clay	Slight	Very Slight
203	Cushman clay loam	Very Slight	Slight
204	Clarkelen sandy clay loam	Very Slight	Slight

[1]Based on silt percentage found in A horizon from lab analysis
[2]Based on sand percentage from 0 to 18 inches from lab analysis

ADDENDUM 3.3-C
SOIL MAPPING UNIT DESCRIPTIONS

"Ba" – Bahl clay loam

The Bahl clay loam mapping unit consists of very deep, well drained soils formed on alluvial fans, fan aprons, hillslopes, and terraces in alluvium from clay shales. It occurs on alluvial fans, fan aprons, hillslopes, and terraces at elevations from 3,500 to 5,000 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 110 to 130 days.

Slopes are simple and range from 0 to 20 percent. Parent material consists of alluvium from clay shales.

A typical profile contains a 6 inch light brownish gray clay loam surface layer. The transition subsoil is a light brownish gray clay that is approximately 6 inches thick. The substratum is a light brownish gray clay that extends to approximately 48 inches in depth.

Permeability within the Bahl soil is slow. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Western wheatgrass, Blue grama, Green needlegrass, Big sagebrush, and Prairie junegrass.

In a favorable year (above average moisture), the production is approximately 1,800 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength and shrink-swell. This map unit is a poor source for topsoil; limitations include sodium content and high clay content. This map unit is a poor source of overall reclamation material; limitations include high clay content, low organic matter content, high sodium content, and water erosion.

"Bo" – Bowbac sandy loam

The Bowbac sandy loam mapping unit consists of moderately deep, well drained soils formed in alluvium, eolian deposits or residuum derived primarily from argillaceous sandstone. It occurs on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges, and buttes at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of alluvium, eolian deposits or residuum derived primarily from argillaceous sandstone.

A typical profile contains a 3 inch brown fine sandy loam surface layer. The transition subsoil is a yellowish brown sandy clay loam that is approximately 36 inches thick. The substratum is argillaceous sandstone.

Permeability within the Bowbac soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Needleandthread, Prairie sandreed, Indian ricegrass, Silver sagebrush, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a fair source for topsoil; limitations include depth to bedrock and slope. This map unit is a poor source of overall reclamation material; limitations include wind erosion, droughtiness, depth to bedrock, and low organic matter content.

"Ca" – Cambria loam

The Cambria loam mapping unit consists of very deep, well drained soils formed in alluvium and slope alluvium from mixed sources. It occurs on fan remnants, fan piedmonts, alluvial fans, hills, ridges and terraces at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of alluvium and slope alluvium from mixed sources.

A typical profile contains a 4 inch brown loam surface layer. The transition subsoil is a brown clay loam that is approximately 6 inches thick. The substratum is a pale brown loam that extends to approximately 50 inches in depth.

Permeability within the Cambria soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Western wheatgrass, Needleandthread, Green needlegrass, Blue grama, Big sagebrush, and Indian ricegrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include slope. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

"Cl" – Clarkelen fine sandy loam

The Clarkelen fine sandy loam mapping unit consists of very deep, well, moderately well, or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. It occurs on flood plains and terraces adjacent to floodplains at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent. Parent material consists of stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock.

A typical profile contains a 6 inch grayish brown fine sandy loam surface layer. The substratum is a light brownish gray stratified loam, fine sandy loam, loamy fine sand, and fine sand that extends to approximately 54 inches in depth.

Permeability within the Clarkelen soil is moderately rapid. Runoff is slow. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate. The soil is subject to occasionally flooding for brief or very brief periods following intense storms in spring and summer or from snowmelt in spring.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Basin wildrye, Green needlegrass, Western wheatgrass, Sandberg bluegrass, Blue grama, Silver sagebrush, Snowberry, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 2,400 lbs/acres. In an unfavorable (drought) year, the production is approximately 1,200 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and droughtiness.

"Cu" – Cushman very fine sandy loam

The Cushman very fine sandy loam mapping unit consists of moderately deep, well drained soils formed in slopewash alluvium and residuum from interbedded shales and siltstone and fine-grained argillaceous sandstone. It occurs on buttes, fan remnants, hills, piedmonts, ridges and terraces at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of moderately fine textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas.

A typical profile contains a 2 inch light brownish gray very fine sandy loam surface layer. The transition subsoil is a brown to yellowish brown clay loam that is approximately 12 inches thick. The substratum is a pale to very pale brown loam that extends to approximately 18 inches in depth.

Permeability within the Cushman soil is moderate. Runoff is medium. The water erosion hazard is very slight and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are four plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, and Green needlegrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and low strength. This map unit is a fair source for topsoil; limitations include depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and water erosion.

"CuNC" – Cushman noncalcareous variant

The Cushman noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in slopewash alluvium and residuum from interbedded shales and siltstone and fine-grained argillaceous sandstone. It occurs on buttes, fan remnants, hills, piedmonts, ridges and terraces at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of moderately fine textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas.

A typical profile contains a 2 inch light brownish gray very fine sandy loam surface layer. The transition subsoil is a brown to yellowish brown clay loam that is approximately 12 inches thick. The substratum is a pale to very pale brown loam that extends to approximately 18 inches in depth.

Permeability within the Cushman soil is moderate. Runoff is medium. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are four plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, and Green needlegrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and low strength. This map unit is a fair source for topsoil; limitations include depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and water erosion.

"De" – Decolney fine sandy loam

The Decolney fine sandy loam mapping unit consists of very deep, well drained soils formed in alluvium or eolian deposits derived from sedimentary beds. It occurs on stabilized dune topography including alluvial fans, fan remnants, pediments, terraces, plateaus, ridges and hills at elevations from 3,500 to 5,200 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of eolian or alluvium deposits derived from mixed sedimentary bedrock.

A typical profile contains a 3 inch brown fine sandy loam surface layer. The transition subsoil is a brown to yellowish brown sandy clay loam that is approximately 19 inches thick. The substratum is a brown to pale brown fine sandy loam that extends to approximately 38 inches in depth.

Permeability within the Decolney soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Threadleaf sedge, Western wheatgrass, Blue grama, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

"Dr" – Draknab loamy sand

The Draknab loamy sand mapping unit consists of very deep, moderately well, well or excessively well drained soils formed in stratified recent stream alluvium. It occurs on flood plains and on adjacent low terrace positions at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent. Parent material consists of coarse textured recent stream alluvium derived originally from sandstone-dominated sedimentary rock.

A typical profile contains a 2 inch yellowish brown loamy sand surface layer. The transition subsoil is a yellowish brown sandy loam that is approximately 6 inches thick. The substratum is a pale brown to very pale brown stratified sand, coarse sand, loamy coarse sand and loamy sand that extends to approximately 52 inches in depth.

Permeability within the Draknab soil is rapid. Runoff is negligible on the gentler slopes and very low on the steeper slopes. This soil is subject to rare to frequent flooding for very brief or brief periods during prolonged, high intensity storms in the spring and early summer. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Needleandthread, Fringed sagewort, Indian ricegrass, Sand dropseed, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 3,000 lbs/acres. In an unfavorable (drought) year, the production is approximately 1,600 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include high sand content. This map unit is a poor source of overall reclamation material; limitations include wind erosion, high sand content, droughtiness, and low organic matter content.

"Dw" – Dwyer fine sand

The Dwyer fine sand mapping unit consists of very deep, excessively drained soils formed in eolian sand. It occurs on dune-like forms frequently on or near the edges of alluvial terraces at elevations from 3,500 to 5,600 feet.

The mean annual precipitation is estimated to be 10 to 16 inches. The mean annual air temperature is 48 degrees Fahrenheit. The frost-free season ranges from 110 to 130 days.

Slopes are irregular and range from 0 to 25 percent. Parent material consists of eolian sand.

A typical profile contains a 6 inch pale brown fine sand surface layer. The substratum is a very pale brown fine sand that extends to approximately 54 inches in depth.

Permeability within the Dwyer soil is rapid. Runoff is very slow on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Needleandthread, Indian ricegrass, Sand dropseed, Silver sagebrush, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,700 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a poor source for topsoil; limitations include high sand content and slope. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion, droughtiness, and low organic matter content.

"EmMV" – Embry moderately deep variant

The Embry moderately deep variant mapping unit consists of moderately deep, well drained soils formed in alluvium and eolian deposits derived from sandstone. It occurs on hills, dunes, terraces and alluvial fans at elevations from 4,200 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 45 to 50 degrees Fahrenheit. The frost-free season ranges from 110 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of alluvium and eolian deposits derived from noncalcareous sandstone.

A typical profile contains a 6 inch light brownish gray sandy loam surface layer. The substratum is a light brownish gray to pale brown sandy loam that extends to approximately 34 inches in depth.

Permeability within the Embry soil is moderately rapid. Runoff is slow on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Blue grama, Silver sagebrush, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include slope. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

"Fo" – Forkwood loam

The Forkwood loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loam surface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

"FoNC-ClNC-ThNC" – Forkwood noncalcareous variant-Clarkelen noncalcareous variant-Theedle noncalcareous variant complex

Forkwood noncalcareous variant

The Forkwood noncalcareous variant mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loam surface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

Clarkelen noncalcareous variant

The Clarkelen noncalcareous variant mapping unit consists of very deep, well, moderately well, or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. It occurs on flood plains and terraces adjacent

to floodplains at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent. Parent material consists of stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock.

A typical profile contains a 6 inch grayish brown fine sandy loam surface layer. The substratum is a light brownish gray stratified loam, fine sandy loam, loamy fine sand, and fine sand that extends to approximately 54 inches in depth.

Permeability within the Clarkelen soil is moderately rapid. Runoff is slow. The water erosion hazard is very slight and the wind erosion hazard is moderate. The soil is subject to occasionally flooding for brief or very brief periods following intense storms in spring and summer or from snowmelt in spring.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Basin wildrye, Green needlegrass, Western wheatgrass, Sandberg bluegrass, Blue grama, Silver sagebrush, Snowberry, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 2,400 lbs/acres. In an unfavorable (drought) year, the production is approximately 1,200 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and droughtiness.

Theedle noncalcareous variant

The Theedle noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"Fo-Sh" – Forkwood-Shingle complex

Forkwood loam

The Forkwood loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loamsurface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

Shingle clay loam

The Shingle clay loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum or colluviums derived from interbedded shale and sandstone or in alluvium from mudstone. It occurs on bedrock controlled hillslopes and ridges at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 80 percent. Parent material consists of colluviums and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay loam that extends to approximately 7 inches in depth.

Permeability within the Shingle soil is moderate. Runoff is medium on the gentler slopes and high on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Needleandthread, Threadleaf sedge, and Big sagebrush.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include depth to bedrock, rock fragments, and slope. This map unit is a poor source of overall reclamation material; limitations include droughtiness, depth to bedrock, and low organic matter content.

"Fo-Th" – Forkwood-Theedle complex

Forkwood loam

The Forkwood loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loam surface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.
A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"Ha" – Haverdad loam

The Haverdad loam mapping unit consists of very deep, well drained soils formed in stratified alluvium. It occurs on floodplains and low terraces at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 43 to 52 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent. Parent material consists of alluvium from mixed sources.

A typical profile contains a 4 inch pale brown loam surface layer. The substratum is a pale brown loam or clay loam stratified with fine sandy loam, sandy loam, loam, silt loam, and silty clay loam that extends to approximately 56 inches in depth.

Permeability within the Haverdad soil is moderate. Runoff is slow. Flooding for brief periods occurs during spring runoff and after thunder showers. The water erosion hazard is slight and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Green needlegrass, Cottonwood, Needleandthread, Slender wheatgrass, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 3,000 lbs/acres. In an unfavorable (drought) year, the production is approximately 1,600 lbs/acres.

According to NRCS information, this map unit is a fair source for roadfill; limitations include low strength and shrink-swell. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a poor source of overall reclamation material; limitations include high alkalinity and low organic matter content.

"Hi" – Hiland fine sandy loam

The Hiland fine sandy loam mapping unit consists of very deep, well drained soils formed in alluvium or eolian deposits. It occurs on relict surfaces consisting of terraces, fans, fan remnants, pediments, ridges, hills and stabilized dunes at elevations from 3,500 to 6,300 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of moderately coarse alluvium and eolian material derived predominantly from sandstone.

A typical profile contains a 6 inch brown to pale brown fine sandy loam surface layer. The transition subsoil is a brown, yellowish brown, or pale brown sandy clay loam that is approximately 25 inches thick. The substratum is a light yellowish brown fine sandy loam that extends to approximately 29 inches in depth.

Permeability within the Hiland soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Needleandthread, Prairie sandreed, Thickspike wheatgrass, Threadleaf sedge, Blue grama, Sand bluestem, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include slope. This map unit is a poor source of overall reclamation material; limitations include wind erosion and low organic matter content.

"HiNC" – Hiland noncalcareous variant

The Hiland noncalcareous variant mapping unit consists of very deep, well drained soils formed in alluvium or eolian deposits. It occurs on relict surfaces consisting of terraces, fans, fan remnants, pediments, ridges, hills and stabilized dunes at elevations from 3,500 to 6,300 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of moderately coarse alluvium and eolian material derived predominantly from sandstone.

A typical profile contains a 6 inch brown to pale brown fine sandy loam surface layer. The transition subsoil is a brown, yellowish brown, or pale brown sandy clay loam that is approximately 25 inches thick. The substratum is a light yellowish brown fine sandy loam that extends to approximately 29 inches in depth.

Permeability within the Hiland soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is severe.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Needleandthread, Prairie sandreed, Thickspike wheatgrass, Threadleaf sedge, Blue grama, Sand bluestem, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include slope. This map unit is a poor source of overall reclamation material; limitations include wind erosion and low organic matter content.

"Ke" – Keeline sandy loam

The Keeline sandy loam mapping unit consists of very deep, well or somewhat excessively drained soils formed in alluvium or eolian deposits derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 40 percent. Parent material consists of moderately coarse alluvium or eolian deposits derived from calcareous sandstone.

A typical profile contains a 3 inch yellowish brown sandy loam surface layer. The transition subsoil is a pale brown sandy loam that is approximately 5 inches thick. The substratum is a very pale brown sandy loam that extends to approximately 52 inches in depth.

Permeability within the Keeline soil is moderately rapid. Runoff is slow. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Needleandthread, Prairie sandreed, Big sagebrush, Blue grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

"KeNC" – Keeline noncalcareous variant

The Keeline noncalcareous variant mapping unit consists of very deep, well or somewhat excessively drained soils formed in alluvium or eolian deposits derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 40 percent. Parent material consists of moderately coarse alluvium or eolian deposits derived from calcareous sandstone.

A typical profile contains a 3 inch yellowish brown sandy loam surface layer. The transition subsoil is a pale brown sandy loam that is approximately 5 inches thick. The substratum is a very pale brown sandy loam that extends to approximately 52 inches in depth.

Permeability within the Keeline soil is moderately rapid. Runoff is slow. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Needleandthread, Prairie sandreed, Big sagebrush, Blue grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

"Ke-De-Th" – Keeline-Decolney-Theedle complex

Keeline sandy loam

The Keeline sandy loam mapping unit consists of very deep, well or somewhat excessively drained soils formed in alluvium or eolian deposits derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 40 percent. Parent material consists of moderately coarse alluvium or eolian deposits derived from calcareous sandstone.

A typical profile contains a 3 inch yellowish brown sandy loam surface layer. The transition subsoil is a pale brown sandy loam that is approximately 5 inches thick. The substratum is a very pale brown sandy loam that extends to approximately 52 inches in depth.

Permeability within the Keeline soil is moderately rapid. Runoff is slow. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Needleandthread, Prairie sandreed, Big sagebrush, Blue grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

Decolney fine sandy loam

The Decolney fine sandy loam mapping unit consists of very deep, well drained soils formed in alluvium or eolian deposits derived from sedimentary beds. It occurs on stabilized dune topography including alluvial fans, fan remnants, pediments, terraces, plateaus, ridges and hills at elevations from 3,500 to 5,200 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 20 percent. Parent material consists of eolian or alluvium deposits derived from mixed sedimentary bedrock.

A typical profile contains a 3 inch brown fine sandy loam surface layer. The transition subsoil is a brown to yellowish brown sandy clay loam that is approximately 19 inches thick. The substratum is a brown to pale brown fine sandy loam that extends to approximately 38 inches in depth.

Permeability within the Decolney soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Threadleaf sedge, Western wheatgrass, Blue grama, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"Ke-Or-Ta" – Keeline-Orpha-Taluce complex

Keeline sandy loam

The Keeline sandy loam mapping unit consists of very deep, well or somewhat excessively drained soils formed in alluvium or eolian deposits derived from sandstone. It occurs on upland ridgetops, hillslopes, terraces, benches, alluvial fans, and fan remnants at elevations from 3,500 to 6,200 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 44 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 40 percent. Parent material consists of moderately coarse alluvium or eolian deposits derived from calcareous sandstone.

A typical profile contains a 3 inch yellowish brown sandy loam surface layer. The transition subsoil is a pale brown sandy loam that is approximately 5 inches thick. The substratum is a very pale brown sandy loam that extends to approximately 52 inches in depth.

Permeability within the Keeline soil is moderately rapid. Runoff is slow. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Needleandthread, Prairie sandreed, Big sagebrush, Blue grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

Orpha loamy sand

The Orpha loamy sand mapping unit consists of very deep, excessively drained soils formed in alluvium or eolian sand from mixed sources. It occurs on rolling dunes, hills, terraces, floodplains, uplands, valley side slopes, toeslopes, and footslopes at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 18 inches. The annual air temperature is 44 to 50 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of alluvium or eolian deposits generally adjacent to and downwind of sandy parent sources.

A typical profile contains a 6 inch grayish brown loamy sand surface layer. The substratum is a light brownish gray sand that extends to approximately 54 inches in depth.

Permeability within the Orpha soil is rapid or very rapid. Runoff is very low on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate to severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Sand bluestem, Needleandthread, Prairie sandreed, Little bluestem, Thickspike wheatgrass, and Sand sagebrush.

In a favorable year (above average moisture), the production is approximately 1,800 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a poor source for topsoil; limitations include high sand content. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion, low organic matter content, and droughtiness.

Taluce sandy loam

The Taluce sandy loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum and slope alluvium derived from sandstone. It occurs on ridges and hills at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 42 to 51 degrees Fahrenheit. The frost-free season ranges from 100 to 130 days.

Slopes range from 3 to 70 percent. Parent material consists of residuum and slope alluvium derived from sandstone.

A typical profile contains a 4 inch yellowish brown sandy loam surface layer. The

substratum is a light yellowish brown sandy loam that extends to approximately 5 inches in depth.

Permeability within the Taluce soil is rapid. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Blue grama, Indian ricegrass, Little bluestem, Sand bluestem, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,300 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and droughtiness.

"Ki" – Kishona loam

The Kishona loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces at elevations from 3,500 to 6,700 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent but range up to 30 percent on dissected slopes. Parent material consists of alluvium derived from sandstones and shales.

A typical profile contains a 4 inch brown loam surface layer. The transition subsoil is a very pale brown silty clay loam that is approximately 20 inches thick. The substratum is a pale brown loam that extends to approximately 36 inches in depth.

Permeability within the Kishona soil is moderate. Runoff is slow on gentler slopes and medium on steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, Big sagebrush, Little bluestem, and Thickspike wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a fair source for roadfill; limitations include low strength and shrink-swell. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

"Ki-Fo" – Kishona-Forkwood complex

Kishona loam

The Kishona loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces at elevations from 3,500 to 6,700 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent but range up to 30 percent on dissected slopes. Parent material consists of alluvium derived from sandstones and shales.

A typical profile contains a 4 inch brown loam surface layer. The transition subsoil is a very pale brown silty clay loam that is approximately 20 inches thick. The substratum is a pale brown loam that extends to approximately 36 inches in depth.

Permeability within the Kishona soil is moderate. Runoff is slow on gentler slopes and medium on steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, Big sagebrush, Little bluestem, and Thickspike wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a fair source for roadfill; limitations include low strength and shrink-swell. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

Forkwood loam

The Forkwood loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loam surface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

"Lo-ThNC" – Lolite-Theedle noncalcareous complex

Lolite clay

The Lolite clay mapping unit consists of shallow, well drained soils formed in residuum. It occurs on ridges and hillsides at elevations from 4,900 to 6,500 feet.

The mean annual precipitation is estimated to be 9 to 14 inches. The annual air temperature is 42 to 51 degrees Fahrenheit. The frost-free season ranges from 110 to 130 days.

Slopes range from 3 to 45 percent. Parent material consists of residuum derived from sodic, noncalcareous shale.

A typical profile contains a 2 inch light brownish gray clay surface layer. The transition subsoil is light brownish gray clay that is approximately 4 inches thick. The substratum is gray clay that extends to approximately 4 inches in depth.

Permeability within the Lolite soil is slow. Runoff is rapid. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Bluebunch wheatgrass, Bottlebrush squirreltail, Gardner's saltbrush, Indian ricegrass, Western wheatgrass, Birdfoot sagebrush, Sandberg bluegrass, and other perennial forbs.

In a favorable year (above average moisture), the production is approximately 200 lbs/acres. In an unfavorable (drought) year, the production is approximately 50 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, slope, and shrink-swell. This map unit is a poor source for topsoil; limitations include depth to bedrock, high clay content, slope, and high sodium content. This map unit is a poor source of overall reclamation material; limitations include droughtiness, high sodium content, depth to bedrock, high clay content, and high salinity.

Theedle noncalcareous variant

The Theedle noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"Or" – Orpha loamy sand

The Orpha loamy sand mapping unit consists of very deep, excessively drained soils formed in alluvium or eolian sand from mixed sources. It occurs on rolling dunes, hills, terraces, floodplains, uplands, valley side slopes, toeslopes, and footslopes at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 18 inches. The annual air temperature is 44 to 50 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of alluvium or eolian deposits generally adjacent to and downwind of sandy parent sources.

A typical profile contains a 6 inch grayish brown loamy sand surface layer. The substratum is a light brownish gray sand that extends to approximately 54 inches in depth.

Permeability within the Orpha soil is rapid or very rapid. Runoff is very low on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate to severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Sand bluestem, Needleandthread, Prairie sandreed, Little bluestem, Thickspike wheatgrass, and Sand sagebrush.

In a favorable year (above average moisture), the production is approximately 1,800 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a poor source for topsoil; limitations include high sand content. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion, low organic matter content, and droughtiness.

"Pe" – Petrie clay loam

The Petrie clay loam mapping unit consists of deep, well drained soils formed in alluvium derived from sodic sedimentary rock. It occurs on fan aprons, fan pediments, and alluvial terraces at elevations from 3,700 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 16 inches. The annual air temperature is 43 to 49 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 10 percent. Parent material consists of alluvium derived from sodic shale and siltstone.

A typical profile contains a 1 inch light yellowish brown clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay that extends to approximately 55 inches in depth.

Permeability within the Petrie soil is very slow. Runoff is slow on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Gardner's saltbrush, Bottlebrush squirreltail, Indian ricegrass, Western wheatgrass, Alkali sacaton, Birdfoot sagebrush, Greasewood, and Winterfat.

In a favorable year (above average moisture), the production is approximately 650 lbs/acres. In an unfavorable (drought) year, the production is approximately 300 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength and shrink-swell hazard. This map unit is a poor source for topsoil; limitations include high sodium content, high clay content, high salinity, and many rock fragments. This map unit is a poor source of overall reclamation material; limitations include high sodium content, high clay content, high alkalinity, water erosion hazard, and low organic matter content.

"Re" – Renohill clay loam

The Renohill clay loam mapping unit consists of moderately deep, well drained soils formed in alluvium, colluviums, and residuum. It occurs on bedrock controlled plateaus, alluvial fans, hills and ridges at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 47 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 30 percent. Parent material consists of alluvium, colluviums, and residuum derived from calcareous shale.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a grayish brown heavy clay loam that is approximately 3 inches thick. The substratum is a light olive brown, light yellowish brown, and light brownish gray clay or clay loam that extends to approximately 23 inches in depth.

Permeability within the Renohill soil is slow. Runoff is low on the gentler slopes and high on the steeper slopes. The water erosion hazard is slight and the wind erosion hazard is negligible.

Productivity and Reclamation Potential

There are four plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, and Green needlegrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength, shallow depth to bedrock, and shrink-swell susceptibility. This map unit is a fair source for topsoil; limitations include high clay content and shallow depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include low organic matter content, high clay content, shallow depth to bedrock, and water erosion susceptibility.

"Sh" – Shingle clay loam

The Shingle clay loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum or colluviums derived from interbedded shale and sandstone or in alluvium from mudstone. It occurs on bedrock controlled hillslopes and ridges at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 80 percent. Parent material consists of colluviums and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay loam that extends to approximately 7 inches in depth.

Permeability within the Shingle soil is moderate. Runoff is medium on the gentler slopes and high on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Needleandthread, Threadleaf sedge, and Big sagebrush.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include depth to bedrock, rock fragments, and slope. This map unit is a poor source of overall reclamation material; limitations include droughtiness, depth to bedrock, and low organic matter content.

"ShNC" – Shingle noncalcareous variant

The Shingle noncalcareous variant mapping unit consists of very shallow or shallow, well drained soils formed in residuum or colluviums derived from interbedded shale and sandstone or in alluvium from mudstone. It occurs on bedrock controlled hillslopes and ridges at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 80 percent. Parent material consists of colluviums and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay loam that extends to approximately 7 inches in depth.

Permeability within the Shingle soil is moderate. Runoff is medium on the gentler slopes and high on the steeper slopes. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Needleandthread, Threadleaf sedge, and Big sagebrush.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include depth to bedrock, rock fragments, and slope. This map unit is a poor source of overall reclamation material; limitations include droughtiness, depth to bedrock, and low organic matter content.

"Sh-Fo-EmMV" – Shingle-Forkwood-Embry moderately deep variant complex

Shingle clay loam

The Shingle clay loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum or colluviums derived from interbedded shale and sandstone or in alluvium from mudstone. It occurs on bedrock controlled hillslopes and ridges at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 80 percent. Parent material consists of colluviums and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay loam that extends to approximately 7 inches in depth.

Permeability within the Shingle soil is moderate. Runoff is medium on the gentler slopes and high on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Needleandthread, Threadleaf sedge, and Big sagebrush.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include depth to bedrock, rock fragments, and slope. This map unit is a poor source of overall reclamation material; limitations include droughtiness, depth to bedrock, and low organic matter content.

Forkwood loam

The Forkwood loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on terraces, alluvial fans, fan remnants, hills, ridges and pediments at

elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 15 percent. Parent material consists of slopewash alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 5 inch brown loamsurface layer. The transition subsoil is a brown to light brownish gray clay loam that is approximately 25 inches thick. The substratum is a light brownish gray loam that extends to approximately 30 inches in depth.

Permeability within the Forkwood soil is moderate. Runoff is low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

Embry moderately deep variant

The Embry moderately deep variant mapping unit consists of moderately deep, well drained soils formed in alluvium and eolian deposits derived from sandstone. It occurs on hills, dunes, terraces and alluvial fans at elevations from 4,200 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 45 to 50 degrees Fahrenheit. The frost-free season ranges from 110 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of alluvium and eolian deposits derived from noncalcareous sandstone.

A typical profile contains a 6 inch light brownish gray sandy loam surface layer. The substratum is a light brownish gray to pale brown sandy loam that extends to approximately 34 inches in depth.

Permeability within the Embry soil is moderately rapid. Runoff is slow on the gentler slopes and medium on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is moderate.

Productivity and Reclamation Potential
There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Blue grama, Silver sagebrush, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a fair source for topsoil; limitations include slope. This map unit is a fair source of overall reclamation material; limitations include low organic matter content.

"Sh-Th-Ki" – Shingle-Theedle-Kishona complex

Shingle clay loam

The Shingle clay loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum or colluviums derived from interbedded shale and sandstone or in alluvium from mudstone. It occurs on bedrock controlled hillslopes and ridges at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 80 percent. Parent material consists of colluviums and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone.

A typical profile contains a 4 inch light brownish gray clay loam surface layer. The transition subsoil is a light yellowish brown clay loam that is approximately 4 inches thick. The substratum is a light yellowish brown clay loam that extends to approximately 7 inches in depth.

Permeability within the Shingle soil is moderate. Runoff is medium on the gentler slopes and high on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Needleandthread, Threadleaf sedge, and Big sagebrush.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include depth to bedrock, rock fragments, and slope. This map unit is a poor source of overall reclamation material; limitations include droughtiness, depth to bedrock, and low organic matter content.

Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled

fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

Kishona loam

The Kishona loam mapping unit consists of very deep, well drained soils formed in alluvium. It occurs on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces at elevations from 3,500 to 6,700 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 6 percent but range up to 30 percent on dissected slopes. Parent material consists of alluvium derived from sandstones and shales.

A typical profile contains a 4 inch brown loam surface layer. The transition subsoil is a very pale brown silty clay loam that is approximately 20 inches thick. The substratum is a pale brown loam that extends to approximately 36 inches in depth.

Permeability within the Kishona soil is moderate. Runoff is slow on gentler slopes and medium on steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, Big sagebrush, Little bluestem, and Thickspike wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a fair source for roadfill; limitations include low strength and shrink-swell. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion.

"TaNC" – Taluce noncalcareous variant

The Taluce noncalcareous variant mapping unit consists of very shallow or shallow, well drained soils formed in residuum and slope alluvium derived from sandstone. It occurs on ridges and hills at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 42 to 51 degrees Fahrenheit. The frost-free season ranges from 100 to 130 days.

Slopes range from 3 to 70 percent. Parent material consists of residuum and slope alluvium derived from sandstone.

A typical profile contains a 4 inch yellowish brown sandy loam surface layer. The substratum is a light yellowish brown sandy loam that extends to approximately 5 inches in depth.

Permeability within the Taluce soil is rapid. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Blue grama, Indian ricegrass, Little bluestem, Sand bluestem, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,300 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and droughtiness.

"TaNC-Or" – Taluce noncalcareous variant-Orpha complex

Taluce noncalcareous variant

The Taluce noncalcareous variant mapping unit consists of very shallow or shallow, well drained soils formed in residuum and slope alluvium derived from sandstone. It occurs on ridges and hills at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 42 to 51 degrees Fahrenheit. The frost-free season ranges from 100 to 130 days.

Slopes range from 3 to 70 percent. Parent material consists of residuum and slope alluvium derived from sandstone.

A typical profile contains a 4 inch yellowish brown sandy loam surface layer. The substratum is a light yellowish brown sandy loam that extends to approximately 5 inches in depth.

Permeability within the Taluce soil is rapid. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Blue grama, Indian ricegrass, Little bluestem, Sand bluestem, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,300 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and droughtiness.

Orpha loamy sand

The Orpha loamy sand mapping unit consists of very deep, excessively drained soils formed in alluvium or eolian sand from mixed sources. It occurs on rolling dunes, hills, terraces, floodplains, uplands, valley side slopes, toeslopes, and footslopes at elevations

from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 18 inches. The annual air temperature is 44 to 50 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of alluvium or eolian deposits generally adjacent to and downwind of sandy parent sources.

A typical profile contains a 6 inch grayish brown loamy sand surface layer. The substratum is a light brownish gray sand that extends to approximately 54 inches in depth.

Permeability within the Orpha soil is rapid or very rapid. Runoff is very low on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is moderate to severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Sand bluestem, Needleandthread, Prairie sandreed, Little bluestem, Thickspike wheatgrass, and Sand sagebrush.

In a favorable year (above average moisture), the production is approximately 1,800 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a good source for roadfill; there are no limitations listed. This map unit is a poor source for topsoil; limitations include high sand content. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion, low organic matter content, and droughtiness.

"Th" – Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"ThNC" – Theedle noncalcareous variant

The Theedle noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

"Th-CuNc" – Theedle-Cushman noncalcareous variant complex

Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

Cushman non-calcareous variant

The Cushman noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in slopewash alluvium and residuum from interbedded shales and siltstone and fine-grained argillaceous sandstone. It occurs on buttes, fan remnants, hills,

piedmonts, ridges and terraces at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 20 percent. Parent material consists of moderately fine textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas.

A typical profile contains a 2 inch light brownish gray very fine sandy loam surface layer. The transition subsoil is a brown to yellowish brown clay loam that is approximately 12 inches thick. The substratum is a pale to very pale brown loam that extends to approximately 18 inches in depth.

Permeability within the Cushman soil is moderate. Runoff is medium. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are four plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, and Green needlegrass.

In a favorable year (above average moisture), the production is approximately 1,500 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and low strength. This map unit is a fair source for topsoil; limitations include depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and water erosion.

"Tl" – Tullock loamy sand

The Tullock loamy sand mapping unit consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. It occurs on dunes, hills and ridges at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 47 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of eolian deposits and residuum derived from sandstone.

A typical profile contains a 5 inch brown loamy sand surface layer. The substratum is a brown and pale brown loamy sand that extends to approximately 26 inches in depth.

Permeability within the Tullock soil is rapid. Runoff is negligible on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Fringed sagewort, Indian ricegrass, Needleandthread, Sand dropseed, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,700 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a poor source for topsoil; limitations include high sand content, steep slope, and shallow depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion susceptibility, droughtiness, low organic matter content, and shallow depth to bedrock.

"TlNC" – Tullock noncalcareous variant

The Tullock noncalcareous variant mapping unit consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. It occurs on dunes, hills and ridges at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 47 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of eolian deposits and residuum derived from sandstone.

A typical profile contains a 5 inch brown loamy sand surface layer. The substratum is a brown and pale brown loamy sand that extends to approximately 26 inches in depth.

Permeability within the Tullock soil is rapid. Runoff is negligible on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Fringed sagewort, Indian ricegrass, Needleandthread, Sand dropseed, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,700 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a poor source for topsoil; limitations include high sand content, steep slope, and shallow depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion susceptibility, droughtiness, low organic matter content, and shallow depth to bedrock.

"TlNC-Ta" – Tullock noncalcareous variant-Taluce complex

Tullock noncalcareous variant

The Tullock noncalcareous variant mapping unit consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. It occurs on dunes, hills and ridges at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 47 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of eolian deposits and residuum derived from sandstone.

A typical profile contains a 5 inch brown loamy sand surface layer. The substratum is a brown and pale brown loamy sand that extends to approximately 26 inches in depth.

Permeability within the Tullock soil is rapid. Runoff is negligible on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Fringed sagewort, Indian ricegrass, Needleandthread, Sand dropseed, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,700 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a poor source for topsoil; limitations include high sand content, steep slope, and shallow depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion susceptibility, droughtiness, low organic matter content, and shallow depth to bedrock.

Taluce sandy loam

The Taluce sandy loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum and slope alluvium derived from sandstone. It occurs on ridges and hills at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 42 to 51 degrees Fahrenheit. The frost-free season ranges from 100 to 130 days.
Slopes range from 3 to 70 percent. Parent material consists of residuum and slope alluvium derived from sandstone.

A typical profile contains a 4 inch yellowish brown sandy loam surface layer. The substratum is a light yellowish brown sandy loam that extends to approximately 5 inches in depth.

Permeability within the Taluce soil is rapid. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit: Needleandthread, Prairie sandreed, Blue grama, Indian ricegrass, Little bluestem, Sand bluestem, Threadleaf sedge, and Western wheatgrass.

In a favorable year (above average moisture), the production is approximately 1,300 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include depth to bedrock, low organic matter content, and droughtiness.

"TlNC-Tu" – Tullock noncalcareous variant-Turnercrest complex

Tullock noncalcareous variant

The Tullock noncalcareous variant mapping unit consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. It occurs on dunes, hills and ridges at elevations from 3,500 to 6,000 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 47 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 45 percent. Parent material consists of eolian deposits and residuum derived from sandstone.

A typical profile contains a 5 inch brown loamy sand surface layer. The substratum is a brown and pale brown loamy sand that extends to approximately 26 inches in depth.

Permeability within the Tullock soil is rapid. Runoff is negligible on the gentler slopes and low on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit: Prairie sandreed, Sand bluestem, Fringed sagewort, Indian ricegrass, Needleandthread, Sand dropseed, and Silver sagebrush.

In a favorable year (above average moisture), the production is approximately 1,700 lbs/acres. In an unfavorable (drought) year, the production is approximately 900 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a poor source for topsoil; limitations include high sand content, steep slope, and shallow depth to bedrock. This map unit is a poor source of overall reclamation material; limitations include high sand content, wind erosion susceptibility, droughtiness, low organic matter content, and shallow depth to bedrock.

Turnercrest fine sandy loam

The Turnercrest fine sandy loam mapping unit consists of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. It occurs on bedrock-controlled hills, fan remnants, ridges, and structural benches at

elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 45 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.
Slopes range from 0 to 30 percent. Parent material consists of eolian or alluvium deposits and sandy residuum.

A typical profile contains a 2 inch brown fine sandy loam surface layer. The substratum is a brown to light gray fine sandy loam that extends to approximately 23 inches in depth.

Permeability within the Turnercrest soil is moderately rapid. Runoff is very low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is slight to severe.

Productivity and Reclamation Potential

There are three plant species that are common to this map unit: Needleandthread, Prairie sandreed, and Indian ricegrass.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a fair source for topsoil; limitations include steep slope, high sand content, and shallow depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include droughtiness, low organic matter content, high sand content, water erosion susceptibility, and shallow depth to bedrock.

"Tu" –Turnercrest fine sandy loam

The Turnercrest fine sandy loam mapping unit consists of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. It occurs on bedrock-controlled hills, fan remnants, ridges, and structural benches at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 45 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 30 percent. Parent material consists of eolian or alluvium deposits and sandy residuum.

A typical profile contains a 2 inch brown fine sandy loam surface layer. The substratum is a brown to light gray fine sandy loam that extends to approximately 23 inches in depth.

Permeability within the Turnercrest soil is moderately rapid. Runoff is very low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible to very slight and the wind erosion hazard is slight to severe.

Productivity and Reclamation Potential

There are three plant species that are common to this map unit: Needleandthread, Prairie sandreed, and Indian ricegrass.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a fair source for topsoil; limitations include steep slope, high sand content, and shallow depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include droughtiness, low organic matter content, high sand content, water erosion susceptibility, and shallow depth to bedrock.

"TuNC" –Turnercrest noncalcareous variant

The Turnercrest noncalcareous variant mapping unit consists of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. It occurs on bedrock-controlled hills, fan remnants, ridges, and structural benches at elevations from 3,200 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 15 inches. The annual air temperature is 45 to 53 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 30 percent. Parent material consists of eolian or alluvium deposits and sandy residuum.

A typical profile contains a 2 inch brown fine sandy loam surface layer. The substratum is a brown to light gray fine sandy loam that extends to approximately 23 inches in depth.

Permeability within the Turnercrest soil is moderately rapid. Runoff is very low on the gentler slopes and medium on the steeper slopes. The water erosion hazard is negligible and the wind erosion hazard is moderate.

Productivity and Reclamation Potential

There are three plant species that are common to this map unit: Needleandthread, Prairie sandreed, and Indian ricegrass.

In a favorable year (above average moisture), the production is approximately 1,600 lbs/acres. In an unfavorable (drought) year, the production is approximately 750 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock. This map unit is a fair source for topsoil; limitations include steep slope, high sand content, and shallow depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include droughtiness, low organic matter content, high sand content, water erosion susceptibility, and shallow depth to bedrock.

"Ul" –Ulm clay loam

The Ulm clay loam mapping unit consists of very deep, well drained soils formed in calcareous alluvium derived from sedimentary rock. It occurs on relict terraces, alluvial fans, fan remnants, plateaus, ridges and hills at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 46 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 18 percent. Parent material consists of fine and medium textured alluvium derived from interbedded shales and argillaceous sandstone.

A typical profile contains a 4 inch grayish brown clay loam surface layer. The transition subsoil is a brown clay that is approximately 21 inches thick. The substratum is a pale brown clay loam that extends to approximately 35 inches in depth.

Permeability within the Ulm soil is moderate to slow. Runoff is medium. The water erosion hazard is very slight and the wind erosion hazard is very slight to slight.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit: Green needlegrass, Western wheatgrass, Blue grama, Big sagebrush, and Cusick's bluegrass

In a favorable year (above average moisture), the production is approximately 1,400 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength and shrink-swell susceptibility. This map unit is a poor source for topsoil; limitations include high clay content. This map unit is a poor source of overall reclamation material; limitations include high clay content, low organic matter content, and water erosion susceptibility.

"Wo" –Worf loam

The Worf loam mapping unit consists of very shallow or shallow, well drained soils formed in residuum and colluvial slopewash weathered from sedimentary rock. It occurs on upland hills and ridges at elevations from 3,500 to 5,600 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 30 percent. Parent material consists of calcareous materials weathered from sedimentary bedrock.

A typical profile contains a 3 inch grayish brown loam surface layer. The transition subsoil is a grayish brown loam that is approximately 2 inches thick. The substratum is a brown to light yellowish brown clay loam or loam that extends to approximately 9 inches in depth.

Permeability within the Worf soil is moderate. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are nine plant species that are common to this map unit: Bluebunch wheatgrass, Blue grama, Needleandthread, Western wheatgrass, Big sagebrush, Indian ricegrass, Needleleaf sedge, Sideoats grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include shallow depth to bedrock, low strength, shrink-swell susceptibility, and steep slope. This map unit is a poor source for topsoil; limitations include shallow depth to bedrock, steep slope, and high clay content. This map unit is a poor source of overall reclamation material; limitations include wind erosion susceptibility, shallow depth to bedrock, droughtiness, low organic matter content, and high clay content.

"WoNC" –Worf noncalcareous variant

The Worf noncalcareous variant mapping unit consists of very shallow or shallow, well drained soils formed in residuum and colluvial slopewash weathered from sedimentary rock. It occurs on upland hills and ridges at elevations from 3,500 to 5,600 feet.

The mean annual precipitation is estimated to be 10 to 17 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 30 percent. Parent material consists of noncalcareous materials weathered from sedimentary bedrock.

A typical profile contains a 3 inch grayish brown loam surface layer. The transition subsoil is a grayish brown loam that is approximately 2 inches thick. The substratum is a brown to light yellowish brown clay loam or loam that extends to approximately 9 inches in depth.

Permeability within the Worf soil is moderate. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is slight.

Productivity and Reclamation Potential

There are nine plant species that are common to this map unit: Bluebunch wheatgrass, Blue grama, Needleandthread, Western wheatgrass, Big sagebrush, Indian ricegrass, Needleleaf sedge, Sideoats grama, and Threadleaf sedge.

In a favorable year (above average moisture), the production is approximately 1,200 lbs/acres. In an unfavorable (drought) year, the production is approximately 450 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include shallow depth to bedrock, low strength, shrink-swell susceptibility, and steep slope. This map unit is a poor source for topsoil; limitations include shallow depth to bedrock, steep slope, and high clay content. This map unit is a poor source of overall reclamation material; limitations include wind erosion susceptibility, shallow depth to bedrock, droughtiness, low organic matter content, and high clay content.

"Zi" – Zigweid loam

The Zigweid loam mapping unit consists of very deep, well drained soils formed in alluvium from mixed sedimentary sources. It occurs on fan aprons, alluvial fans, fan piedmonts, fan remnants, terraces, ridges and hills at elevations from 3,500 to 6,600 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of calcareous, moderately fine textured sediments derived from interbedded shale and soft sandstone.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a brown clay loam that is approximately 13 inches thick. The substratum is a brown to pale brown loam or clay loam that extends to approximately 43 inches in depth.

Permeability within the Zigweid soil is moderate. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Western wheatgrass, Needleandthread, Big sagebrush, Bluebunch wheatgrass, Green needlegrass, and Muttongrass.

In a favorable year (above average moisture), the production is approximately 1,400 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength and shrink-swell susceptibility. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion susceptibility.

"ZiNC-Th" – Zigweid noncalcareous variant-Theedle complex

Zigweid noncalcareous variant

The Zigweid noncalcareous variant mapping unit consists of very deep, well drained soils formed in alluvium from mixed sedimentary sources. It occurs on fan aprons, alluvial fans, fan piedmonts, fan remnants, terraces, ridges and hills at elevations from 3,500 to 6,600 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 43 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 20 percent. Parent material consists of noncalcareous, moderately fine textured sediments derived from interbedded shale and soft sandstone.

A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a brown clay loam that is approximately 13 inches thick. The substratum is a brown to pale brown loam or clay loam that extends to approximately 43 inches in depth.

Permeability within the Zigweid soil is moderate. Runoff is medium on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is slight and the wind erosion hazard is very slight.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Western wheatgrass, Needleandthread, Big sagebrush, Bluebunch wheatgrass, Green needlegrass, and Muttongrass.

In a favorable year (above average moisture), the production is approximately 1,400 lbs/acres. In an unfavorable (drought) year, the production is approximately 600 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include low strength and shrink-swell susceptibility. This map unit is a good source for topsoil; there are no limitations listed. This map unit is a fair source of overall reclamation material; limitations include low organic matter content and water erosion susceptibility.

Theedle loam

The Theedle loam mapping unit consists of moderately deep, well drained soils formed in residuum and slope alluvium weathered from soft sandstone. It occurs on rock-controlled

fan aprons, fan pediments, and undulating to rolling uplands at elevations from 3,500 to 6,500 feet.

The mean annual precipitation is estimated to be 10 to 14 inches. The annual air temperature is 45 to 51 degrees Fahrenheit. The frost-free season ranges from 105 to 130 days.

Slopes range from 0 to 75 percent. Parent material consists of medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale.
A typical profile contains a 4 inch light brownish gray loam surface layer. The transition subsoil is a light brownish gray loam that is approximately 4 inches thick. The substratum is a light gray loam that extends to approximately 20 inches in depth.

Permeability within the Theedle soil is moderate. Runoff is slow on the gentler slopes and rapid on the steeper slopes. The water erosion hazard is very slight to slight and the wind erosion hazard is very slight to moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit: Needleandthread, Western wheatgrass, Blue grama, Big sagebrush, Little bluestem, and Winterfat.

In a favorable year (above average moisture), the production is approximately 1,900 lbs/acres. In an unfavorable (drought) year, the production is approximately 700 lbs/acres.

According to NRCS information, this map unit is a poor source for roadfill; limitations include depth to bedrock, low strength, shrink-swell, and slope. This map unit is a poor source for topsoil; limitations include slope and depth to bedrock. This map unit is a fair source of overall reclamation material; limitations include depth to bedrock, low organic matter content, droughtiness, and water erosion.

ADDENDUM 3.3-D
SAMPLED SOIL SERIES DESCRIPTIONS

WORF
CLAY LOAM

Soil Mapping Unit "Wo"
Lab Sample ID: C08100869-001_003
BKS Sample ID: #137

Typical Pedon: Worf clay loam- rangeland. (Colors are for dry soil unless otherwise stated.)

The Worf series consists of well drained soils that are very shallow or shallow to bedrock. They formed in residuum and colluvial slopewash weathered from sedimentary rock. Worf soils are on upland hills and ridges and have slopes of 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 45 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; strong very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; noneffervescent; neutral (pH 6.6); clear smooth boundary. (2 to 4 inches thick)

AB - 2 to 5 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure parting to moderate very fine granular; slightly hard, very friable, moderately sticky and slightly plastic; many fine and very fine roots; few faint clay films on vertical faces of peds; noneffervescent; neutral (pH 6.6); clear smooth boundary. (2 to 3 inches thick)

Bw - 5 to 12 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, very friable, moderately sticky and moderately plastic; many fine roots; many distinct clay films on faces of peds, common faint clay films in root channels and pores; noneffervescent; neutral (pH 6.8); clear wavy boundary. (4 to 11 inches thick)

C - 12 to 19 inches; light yellowish brown (10YR 6/4) gravelly clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, moderately sticky and slightly plastic; common fine and medium roots; noneffervescent, neutral (pH 7.0); gradual wavy boundary. (4 to 7 inches thick)

Cr - 19 to 60 inches; moderately to strongly calcareous grey, white and brown shale interbedded with sandstone.

Type Location - Johnson County, Wyoming; refer to waypoint 137 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to calcareous material ranges from 4 to 10 inches; depth to bedrock ranges from 8 to 20 inches. The soil is 90 to 100 percent base saturated. Rock fragments range from 0 to 15 percent but are typically less than 5 percent and are mostly soft shale fragments. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

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

The Bt horizon has hue of 2.5Y through 7.5YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 through 4. It is typically light clay loam but may be loam or sandy clay loam with clay ranging from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with 15 to 35 percent being fine sand or coarser. Reaction is neutral to moderately alkaline.

The Bk or Btk horizon has hue of 5Y through 10YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Calcium carbonate equivalent is 3 to 12 percent. Texture is loam or fine sandy loam in the Bk and clay loam or sandy clay loam in the Btk. Reaction is slightly alkaline through strongly alkaline.

Range in Characteristics (according to field observations, lab analysis): A cambic and C horizon were identified instead of an argillic and calcic horizons. Textures are finer than typical for this series.

Taxonomic Class - Loamy, mixed, superactive, mesic, shallow Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 5-12 inches. Estimated stripping depth is 19 inches.

Geographic Setting (According to Official Series Description) - These soils are on upland hills and ridges. Slopes range from 0 to 30 percent and are both simple and complex. Elevation is 3,500 to 5,600 feet. These soils formed in calcareous materials weathered from sedimentary bedrock. The mean annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 17 inches. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

TALUCE
NONCALCAREOUS VARIANT

Soil Mapping Unit "TaNC"
Lab Sample ID: C08100869-004_005
BKS Sample ID: #138

Typical Pedon: Taluce sandy loam-on a convex north-facing slope, used as rangeland. (Colors are for dry soil unless otherwise stated.)

The Taluce series consists of well drained soils that are very shallow or shallow to soft sandstone. They formed in residuum and slope alluvium derived from sandstone. They are on ridges and hills. Slopes range from 3 to 70 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 4 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; noneffervescent, neutral (pH 7.2); clear smooth boundary. (1 to 4 inches thick)

C - 4 to 15 inches; very pale brown (10YR 7/4) gravelly sandy loam, light yellowish brown (10YR 6/4) moist; weak medium platy rock structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; noneffervescent, slightly alkaline (pH 7.4). (5 to 18 inches thick)

Cr - 15 inches; soft, platy, slightly to noncalcareous sandstone.

Type Location - Natrona County, Wyoming; refer to waypoint 138 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to bedrock ranges from 6 to 20 inches. Rock fragments range from 0 to 15 percent. The particle-size control section has 10 to 18 percent clay. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period.

The A horizon has a hue of 10YR or 2.5Y value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 6. It is fine sandy loam, very fine sandy loam, sandy loam, loamy sand or loamy fine sand. Reaction is neutral to moderately alkaline. Some pedons have a thin Bw horizon. Rock fragments range from 0 to 20 percent.

The C horizon has hue of 2.5Y or 10YR, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 6. It is sandy loam, fine sandy loam or very fine sandy loam and has 10 to 18 percent clay. Reaction is slightly alkaline to strongly alkaline. Rock fragments range from 0 to 20 percent.

The Cr horizon is slightly calcareous sandstone that can be interbedded with mudstone or shale.

Range in Characteristics (according to field observations, lab analysis): The profile is noncalcareous throughout.

Taxonomic Class - Loamy, mixed, superactive, noncalcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 15 inches.

Geographic Setting (According to Official Series Description) - Taluce soils are on ridges and hills. Slope ranges from 3 to 70 percent. They formed in residuum and slope alluvium derived from sandstone. The mean annual precipitation ranges from 10 to 17 inches with over half of the precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 42 to 51 degrees F. Elevation is 3,500 to 6,500 feet. The frost-free season is 100 to 130 days.

HAVERDAD
CLAY LOAM

Soil Mapping Unit "Ha"
Lab Sample ID: C08100869-006_010
BKS Sample ID: #139

Typical Pedon: Haverdad clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 2 inches; brown (10YR 4/3) clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots throughout; carbonates are disseminated throughout; strongly effervescent; neutral (pH 7.2); gradual smooth boundary. (2 to 8 inches thick)

AC - 2 to 7 inches; grayish brown (10YR 5/2) clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots throughout; noneffervescent; neutral (pH 7.2); gradual smooth boundary. (2 to 8 inches thick)

C1 - 7 to 16 inches; light brownish gray (10YR 6/2) loam, dark brownish gray (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots throughout; carbonates are disseminated throughout; slightly effervescent; slightly alkaline (pH 7.4); clear smooth boundary.

C2 - 16 to 20 inches; very pale brown (10YR 7/4) loam, stratified with fine sandy loam, sand loam, clay loam, and silt loam, yellowish brown (10YR 5/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; noneffervescent; slightly alkaline (pH 7.4); gradual smooth boundary.

2Ck1 - 20 to 36 inches; light brownish gray (10YR 6/2) clay loam, stratified with fine sandy loam, loam, silt loam, and silty clay loam, grayish brown (10YR 5/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; carbonates are disseminated throughout; strongly effervescent; slightly alkaline (pH 7.6); gradual smooth boundary.

2Ck2 - 36 to 46 inches; yellowish brown (10YR 5/4) clay, stratified with fine sandy loam, loam, silt loam, and silty clay loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; carbonates are disseminated throughout; moderately effervescent; slightly alkaline (pH 7.7); gradual smooth boundary.

2Ck3 - 46 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, stratified with fine sandy loam, loam, silt loam, and clay loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; carbonates are disseminated throughout; strongly effervescent; slightly alkaline (pH 7.7); gradual smooth boundary.

Type Location - Niobrara County, Wyoming; refer to waypoint 139 on map included in this report.

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

Mean annual soil temperature: 48 to 53 degrees F and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 195 days.
Organic carbon content: .5 to 1.0 percent and decreases irregularly with depth
Rock fragments: 0 to 15 percent gravel
EC (mmhos/cm): 0 to 8 mmhos throughout but where irrigated some soils may range up to 16 mmhos
Calcium sulfate occurs in some pedons.
The soil is typically calcareous to the surface, but some pedons are leached as deep as 20 inches.

A horizon:
Hue: 10YR or 2.5Y
Value: 4 through 6 dry, 3 through 5 moist
Chroma: 2 through 4 dry or moist
Texture: loam, clay loam, silt loam, silty clay loam, very fine sandy loam, fine sandy loam, sandy loam
Reaction: slightly alkaline through strongly alkaline

Some pedons have an AC horizon.

C horizon:
Hue: 10YR or 2.5Y
Value: 5 through 7 dry, 4 to 6 moist
Chroma: 2 through 4 dry or moist
Texture: variable but when averaged is loam or light clay loam with 18 to 35 percent clay
Calcium carbonate equivalent: 1 to 15 percent which changes erratically between strata
Reaction: slightly alkaline through strongly alkaline

Range in Characteristics (according to field observations, lab analysis): Calcic horizons were found towards the bottom of the profile, which is not typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 36-46 inches. Saturation percentage was marginal at 36-46 inches. Estimated stripping depth is 20 inches.

Geographic Setting (According to Official Series Description) –
Parent material: alluvium from mixed sources
Landform: floodplains and low terraces
Elevations: 3,500 to 6,500 feet
Slopes: 0 to 6 percent
Mean annual precipitation: about 11 inches, ranging 10 to 17, with over half of annual precipitation falling in April, May, and June
Mean annual temperature: about 45 degrees F and ranges from 43 to 52 degrees F
Frost-free period: 105 to 130 days

ORPHA
SANDY CLAY LOAM

Soil Mapping Unit "Or"
Lab Sample ID: C08100869-011_016
BKS Sample ID: #140

Typical Pedon: Orpha sandy clay loam-on a west facing dune slope of 6 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Orpha series consists of very deep, excessively drained soils on rolling dunes, hills, terraces, floodplains, uplands, valley side slopes, toeslopes, and footslopes. They formed in alluviium or eolian sand from mixed sources. Slopes range from 0 to 45 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; weak medium and coarse granular structure; loose, soft, nonsticky and nonplastic; noneffervescent; neutral (pH 7.0); gradual wavy boundary. (2 to 6 inches thick)

AC - 2 to 9 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak medium and coarse granular structure; loose, soft, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.0); gradual wavy boundary. (2 to 7 inches thick)

C1 - 9 to 13 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.4).

C2 - 13 to 20 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.4).

C3 - 20 to 28 inches; grayish brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.5).

C4 - 28 to 35 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.5).

2C5 - 35 to 45 inches; light gray (10YR 7/1) clay, gray (10YR 6/1) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, very friable, moderately sticky and moderately plastic; many distinct clay films on faces of peds, common faint clay films in root channels and pores; noneffervescent; slightly alkaline (pH 7.6); clear wavy boundary.

2C6 - 45 to 55 inches; white (10YR 8/1) clay, light gray (10YR 7/1) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, very friable, moderately sticky and moderately plastic; many distinct clay films on faces of peds, common faint clay films in root channels and pores; moderately effervescent; moderately alkaline (pH 7.9); clear wavy boundary.

2Cn - 55 to 60 inches; white (10YR 8/1) clay, light gray (10YR 7/1) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, very friable, moderately sticky and moderately plastic; many distinct clay films on faces of peds, common faint clay films in root channels and pores; strongly effervescent; slightly alkaline (pH 7.6); clear wavy boundary.

Type Location - Converse County, Wyoming; refer to waypoint 140 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Rock fragments are less than 15 percent in the particle-size control section. Depth to carbonates is typically greater than 40 inches but may be 30 inches in some pedons. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is never moist in all parts for as long as 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 44 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry, 3 to 6 moist, and chroma of 2 to 4. Texture is sand, fine sand, loamy sand and loamy fine sand. Reaction is neutral or slightly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 dry, 4 to 7 moist, and chroma of 2 to 6. Texture is sand, fine sand, loamy sand or loamy fine sand. Some pedons may have thin strata of sandy loam or fine sandy loam where they are near the parent source. Reaction ranges from neutral to moderately alkaline. Some pedons have AC horizons.

Range in Characteristics (according to field observations, lab analysis): Textures in the top 35 inches are slightly finer than typical. The bottom portion of the profile has a fine texture, which is not typical of this series.

Taxonomic Class - Mixed, mesic Ustic Torripsamments

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 35-60 inches. Saturation percentage was marginal at 45-55 inches. Estimated stripping depth is 45 inches.

Geographic Setting (According to Official Series Description) - Orpha soils occur primarily as rolling or hilly dunes. They are on hills, valley side slopes, footslopes, toeslopes, stream terraces, broad floodplains and uplands. They formed in alluvium or eolian deposits generally adjacent to and downwind of sandy parent sources. Slopes are usually 0 to 45 percent. In Nebraska slopes are as high as 60 percent. Elevations are 3,500 to 6,500 feet. Precipitation ranges from 10 to 18 inches with over half the annual precipitation falling in April, May, and June. The mean annual air temperature ranges from 44 to 50 degrees F. The frost-free season is about 105 to 130 days.

TULLOCK
SANDY CLAY LOAM

Soil Mapping Unit "Tl"
Lab Sample ID: C08100869-017_018
BKS Sample ID: #141

Typical Pedon: Tullock sandy clay loam-in rangeland. (Colors are for dry soil unless otherwise stated.)

The Tullock series consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. They are on dunes, hills and ridges. Slopes are 0 to 45 percent. The mean annual precipitation is about 12 inches. The mean annual air temperature is about 46 degrees F.

A - 0 to 2 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium and fine granular structure; loose; noneffervescent; neutral (pH 7.2); clear wavy boundary. (2 to 6 inches thick)

AC - 2 to 11 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium and fine granular structure; loose; noneffervescent; neutral (pH 7.2); clear wavy boundary.

C - 11 to 15 inches; very pale brown (10YR 7/3) gravelly sandy clay loam, pale brown (10YR 6/3) moist; massive; loose; noneffervescent; slightly alkaline (pH 7.7); clear wavy boundary. (0 to 18 inches thick)

Ck - 15 to 21 inches; pale brown (10YR 6/3) gravelly sandy clay loam, brown (10YR 5/3) moist; massive; loose; strongly effervescent; carbonates disseminated throughout; slightly alkaline (pH 7.7); clear wavy boundary.

Cr - 21 inches; soft, violently calcareous sandstone.

Type Location - Converse County, Wyoming; refer to waypoint 141 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - These soils typically effervesce throughout but some in some pedons the A horizon is leached. Depth to paralithic contact is 20 to 40 inches. The soil has 0 to 15 percent rock fragments. These soils are usually dry in the moisture control section for 60 consecutive days and 90 cumulative days between July 15 and October 25. The soil temperature at a depth of 20 inches is 41 degrees F or warmer for 175 to 192 days. The mean annual soil temperature is 47 to 53 degrees F.

The A horizon has hue of 2.5Y or 10YR value of 5 or 6 and 3 to 5 moist, and chroma of 2 to 5. It is loamy sand, sand, loamy fine sand, fine sandy loam or fine sand. It is neutral to moderately alkaline.

Some pedons have an AC horizon. When present, it has hue or 2.5Y or 10YR, value of 5 or 6 and 4 or 5 moist, and chroma of 3 or 4. It is loamy sand, loamy fine sand, fine sand or sand.

The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 6. It is loamy sand, loamy fine sand, fine sand or sand. It is slightly alkaline or moderately alkaline.

The Cr horizon is soft calcareous sandstone which may be interbeded with conglomerate or shale in some areas.

Range in Characteristics (according to field observations, lab analysis): Textures are finer than typical for this series. A calcic horizon was identified, which is not typical.

Taxonomic Class - Mixed, mesic Ustic Torripsamments

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal at 0-11 inches. Estimated stripping depth is 15 inches.

Geographic Setting (According to Official Series Description) - Tullock soils are on dunes and footslopes and toeslopes of hills and ridges. They formed in eolian deposits and residuum derived from sandstone. Slopes are 0 to 45 percent. Elevation is 3500 to 6,000 feet. Mean annual soil temperature is 47 to 53 degrees F. Mean annual precipitation is 10 to 14 inches. The frost-free period is 105 to 130 days.

TALUCE
SANDY LOAM

Soil Mapping Unit "Ta"
Lab Sample ID: C08100869-019_020
BKS Sample ID: #142

Typical Pedon: Taluce sandy loam-on a convex north-facing slope, used as rangeland. (Colors are for dry soil unless otherwise stated.)

The Taluce series consists of well drained soils that are very shallow or shallow to soft sandstone. They formed in residuum and slope alluvium derived from sandstone. They are on ridges and hills. Slopes range from 3 to 70 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 1 inch; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; noneffervescent, slightly alkaline (pH 7.8); clear smooth boundary. (1 to 4 inches thick)

AC - 1 to 8 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; noneffervescent, slightly alkaline (pH 7.8); clear smooth boundary.

Ck - 8 to 16 inches; very pale brown (10YR 8/2) sandy loam, light gray (10YR 7/2) moist; weak medium platy rock structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; strongly to violently effervescent, calcium carbonate disseminated; moderately alkaline (pH 7.9). (5 to 18 inches thick)

Cr - 16 inches; soft, platy sandstone.

Type Location - Natrona County, Wyoming; refer to waypoint 142 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to bedrock ranges from 6 to 20 inches. Typically, these soils are calcareous throughout, but some pedons are leached to a depth of as much as 4 inches. Rock fragments range from 0 to 15 percent. The particle-size control section has 10 to 18 percent clay. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27. It is dry in all parts of the moisture control

section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period.

The A horizon has a hue of 10YR or 2.5Y value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 6. It is fine sandy loam, very fine sandy loam, sandy loam, loamy sand or loamy fine sand. Reaction is neutral to moderately alkaline. Some pedons have a thin Bw horizon. Rock fragments range from 0 to 20 percent.

The C horizon has hue of 2.5Y or 10YR, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 6. It is sandy loam, fine sandy loam or very fine sandy loam and has 10 to 18 percent clay. Some pedons have slight accumulations of calcium carbonate. Reaction is slightly alkaline to strongly alkaline. Rock fragments range from 0 to 20 percent.

The Cr horizon is calcareous sandstone that can be interbedded with mudstone or shale.

Range in Characteristics (according to field observations, lab analysis): This profile contains an AC and calcic horizon, which are not typical.

Taxonomic Class - Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal at 8-16 inches. Estimated stripping depth is 8 inches.

Geographic Setting (According to Official Series Description) - Taluce soils are on ridges and hills. Slope ranges from 3 to 70 percent. They formed in residuum and slope alluvium derived from sandstone. The mean annual precipitation ranges from 10 to 17 inches with over half of the precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 42 to 51 degrees F. Elevation is 3,500 to 6,500 feet. The frost-free season is 100 to 130 days.

LOLITE
CLAY

Soil Mapping Unit "Lo"
Lab Sample ID: C08100869-021_022
BKS Sample ID: #146

Typical Pedon: Lolite clay-rangeland. (Colors are for dry soil unless otherwise stated.)

The Lolite series consists of well drained, slowly permeable soils that are shallow to noncalcareous sodic shale on ridges and hillsides. They formed in residuum. Slopes range from 3 to 45 percent. The mean annual precipitation is about 11 inches, and the mean annual temperature is about 45 degrees F.

A - 0 to 3 inches; gray (5YR 6/1) clay, dark gray (5YR 4/1) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; common fine roots; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary. (0.25 to 3 inches thick)

Bt - 3 to 9 inches; pinkish gray (7.5YR 7/2) clay, brown (7.5YR 5/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary. (0 to 6 inches thick)

C - 9 to 24 inches; light brownish gray (10YR 6/2) clay, grayish brown(10YR 5/2) moist; fine platy shale rock structure; hard, firm, sticky and plastic; few fine roots; few fine clusters of sodium sulfate crystals inherited from the parent material; ESP of 35; noneffervescent; slightly alkaline (pH 7.6). (3 to 18 inches thick)

Cr - 24 inches; soft, platy, strongly sodic shale.

Type Location - Natrona County, Wyoming; refer to waypoint 146 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to bedrock ranges from 6 to 20 inches. The particle-size control section is clay, silty clay, or clay loam with 35 to 55 percent clay and less than 35 percent fine sand or coarser. The mean annual soil temperature is 47 to 52 degrees F. Hue is 2.5Y or 5Y, value is 5 or 6 dry, 3 through 5 moist, and chroma is 1 through 3. It is mildly alkaline or moderately alkaline.

The A horizon typically is noncalcareous, however, in some pedons it is calcareous from dust and overflow. ESP is less than 15. Salinity is less than 4 mmhos. A vesicular crust is on some pedons.

The By horizon has less than 5 percent gypsum. ESP is less than 15. Salinity is less than 4 mmhos. Some pedons do not have a By horizon.

The C horizon has platy shale rock structure, however, roots can penetrate the platy fragments. Salt crystals, dominantly sodium sulfate, are inherited from the parent material with only slight alteration. ESP is commonly greater than 20 and ranges from 15 to 60. Salinity is commonly greater than 10 mmhos and ranges from 8 to 20 mmhos.

The Cr is soft, platy, noncalcareous, sodic shale. It is frequently more than 20 feet thick.

Range in Characteristics (according to field observations, lab analysis): An argillic horizon was found in place of a gypsic horizon.

Taxonomic Class - Clayey, mixed, superactive, nonacid, mesic, shallow Typic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-24 inches. Estimated stripping depth is 9 inches.

Geographic Setting (According to Official Series Description) - Lolite soils are on ridges and hillsides. Slopes range from 3 to 45 percent and are mainly convex. They formed in residuum derived from sodic, noncalcareous shale. These soils are often intermixed with rock outcrop and gullied land. The mean annual precipitation is 9 to 14 inches, and the mean annual temperature is 42 to 51 degrees F. The frost-free season is 110 to 130 days. Elevation is 4,900 to 6,500 feet.

HILAND
SANDY CLAY LOAM

Soil Mapping Unit "Hi"
Lab Sample ID: C08100869-023_027
BKS Sample ID: #148

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

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

A - 0 to 3 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; weak medium granular structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; many very fine and common fine roots; noneffervescent; neutral (pH 7.0); abrupt smooth boundary. (2 to 5 inches thick)

Bw - 3 to 9 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure parting to strong fine and medium angular blocky; hard, friable, moderately sticky and moderately plastic; many very fine roots in a mat at the top of the horizon and common very fine roots between peds; many fine pores; noneffervescent; neutral (pH 7.0); clear wavy boundary.

BC - 9 to 17 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, moderately sticky and moderately plastic; common very fine roots between peds; many fine pores; noneffervscent; neutral (pH 7.3); gradual wavy boundary.

Ck1 - 17 to 24 inches; very pale brown (10YR 7/3) clay loam to loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; few fine and medium rounded light gray (10YR 7/2) masses of carbonate throughout; strongly effervescent; moderately alkaline (pH 8.1); gradual smooth boundary.

Ck2 - 24 to 37 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; few fine and medium rounded light gray (10YR 7/2) masses

of carbonate throughout; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

C - 37 to 60 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; slightly effervescent; moderately alkaline (pH 8.3); gradual smooth boundary.

Type Location - Converse County, Wyoming; refer to waypoint 148 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

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

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

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

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

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 7 moist, and chroma of 2 to 4. It is sandy loam, loamy sand, fine sandy loam or sandy clay loam; or, when other textures occur, the horizon average must be sandy loam, loamy sand or fine sandy loam. It is not a calcic horizon. It does not have 5 percent more calcium carbonate equivalent than the underlying horizon or has less than 5 percent secondary carbonates. It is moderately or strongly alkaline. Exchangeable sodium is less than 15 percent even though field tests indicate strongly alkaline reactions.

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

Range in Characteristics (according to field observations, lab analysis): Cambic and BC horizons were found in place of E and argillic horizons. The Ck1 horizon has a finer texture than what is typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found. Estimated stripping depth is 17 inches.

Geographic Setting (According to Official Series Description) - Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

TURNERCREST
SANDY LOAM

Soil Mapping Unit "Tu"
Lab Sample ID: C08100869-028_031
BKS Sample ID: #150

Typical Pedon: Turnercrest sandy loam-on a northeast facing hill footslope of 8 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Turnercrest soils consist of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. They are on bedrock-controlled hills, fan remnants, ridges and structural benches. Slopes range from 0 to 30 percent. The average annual precipitation is about 12, and the mean annual air temperature is about 47 degrees F.

A - 0 to 2 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; many fine and very fine roots; noneffervescent; neutral (pH 7.3); clear smooth boundary. (2 to 6 inches thick)

Bw1 - 2 to 5 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; weak medium and coarse subangular blocky structure; soft, friable; common fine and very fine roots; noneffervescent; neutral (pH 7.3); gradual smooth boundary. (0 to 8 inches thick)

Bw2 - 5 to 12 inches; light brownish gray (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse subangular blocky structure; soft, friable; common fine and very fine roots; noneffervescent; slightly alkaline (pH 7.7); gradual smooth boundary. (0 to 8 inches thick)

C1 - 12 to 20 inches; light gray (10YR 7/2) loamy sand, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots to 15 inches; moderately effervescent; carbonates disseminated and as few fine filaments; moderately alkaline (pH 8.3); clear wavy boundary.

C2 - 20 to 35 inches; very pale brown (10YR 7/3) loamy sand, light yellowish brown (10YR 6/4) moist; massive; slightly hard, very friable; few fine roots to 15 inches; slightly effervescent; carbonates disseminated and as few fine filaments; moderately alkaline (pH 8.4); clear wavy boundary.

Cr - 35 inches; soft, tan and white, noncalcareous sandstone.

Type Location - Weston County, Wyoming; refer to waypoint 150 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, calcareous sandstone ranges from 20 to 40 inches. These soils are typically calcareous throughout but may be leached as much as to 6 inches in some pedons. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F or warmer and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle-size control section is fine sandy loam or sandy loam with 7 to 18 percent clay and 52 to 80 percent sand with more than 15 percent being fine sand or coarser. EC is 0 to 2 mmhos throughout the soil. Rock fragments may be present but break down on pretreatment and do not have lithic properties.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 and 3 to 5 moist, and chroma of 2 to 4. Textures are loamy sand, loamy fine sand, fine sandy loam or sandy loam. Reaction is neutral to moderately alkaline.

The Bw horizon, where present, has hue of 10YR or 2.5Y, value of 5 or 6 and 3 to 5 moist, and chroma of 2 or 3. Depth to the base of the Bw horizon is less than 10 inches. Texture is fine sandy loam or sandy loam. Reaction is slightly alkaline or moderately alkaline.

The Bk has hue of 10YR or 2.5Y, value of 5 to 7 and 3 to 6 moist, and chroma of 2 or 3. Texture is fine sandy loam, very fine sandy loam or sandy loam. Reaction is slightly or moderately alkaline.

The C horizon, when present, has hue of 10YR or 2.5Y, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 4. Texture is fine sandy loam, very fine sandy loam or sandy loam. Some pedons have thin layers of loamy fine sand. Reaction is slightly alkaline or moderately alkaline.

The Cr horizon has a paralithic contact to soft, calcareous sandstone. The sandstone has hue of 10YR or 2.5Y.

Range in Characteristics (according to field observations, lab analysis): This profile is less calcareous than typical, resulting in cambic horizons rather than calcic.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal at 20-35 inches. Estimated stripping depth is 20 inches.

Geographic Setting (According to Official Series Description) - Turnercrest soils are on hills, ridges, fan remnants and structural benches. They formed in eolian or alluvium deposits and sandy residuum. Slopes are 0 to 30 percent. Elevations are 3,200 to 6,500 feet. The average annual precipitation is 10 to 15 inches with over half falling as snow or rain in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 45 to 53 degrees F. The frost-free season is 105 to 130 days.

THEEDLE
NONCALCAREOUS VARIANT

Soil Mapping Unit "ThNC"
Lab Sample ID: C08100869-032_033
BKS Sample ID: #151

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

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

A - 0 to 4 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (0 to 5 inches thick)

AC - 4 to 7 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (3 to 10 inches thick)

C - 7 to 24 inches; very pale brown (10YR 8/4) clay, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; noneffervescent; slightly alkaline (pH 7.7); clear smooth boundary. (14 to 26 inches thick)

Cr - 24 inches; light gray, soft, noncalcareous shale.

Type Location - Weston County, Wyoming; refer to waypoint 151 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, gray, calcareous sandstone or sandy shale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual

soil temperature is 47 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

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

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

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

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. The C horizon has a finer texture than what is typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 7-24 inches. Estimated stripping depth is 7 inches.

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

FORKWOOD
SANDY CLAY LOAM

Soil Mapping Unit "Fo"
Lab Sample ID: C08100869-034_038
BKS Sample ID: #152

Typical Pedon: Forkwood sandy clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 5 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary. (1 to 6 inches thick)

AB - 5 to 9 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bt - 9 to 19 inches; dark yellowish brown (10YR 4/6) sandy clay loam, dark yellowish brown (10YR 3/6) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (6 to 20 inches thick)

Ck1 - 19 to 39 inches; gray (10YR 6/1) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and sligtly plastic; few fine roots throughout; few fine threads and masses of carbonates throughout; violently effervescent; moderately alkaline (pH 8.1); gradual wavy boundary.

Ck2 - 39 to 55 inches; gray (10YR 5/1) sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and sligtly plastic; few fine roots throughout; few fine threads and masses of carbonates throughout; moderately effervescent; moderately alkaline (pH 8.3); gradual wavy boundary.

C - 55 to 60 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots throughout; slightly effervescent; moderately alkaline (pH 8.3). (0 to 40 inches thick)

Type Location - Niobrara County, Wyoming; refer to waypoint 152 on map included in this report.

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

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): The AB horizon is not typical for this series. Textures are slightly sandier than typical for the series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 19 inches.

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

KEELINE
SANDY LOAM

Soil Mapping Unit "Ke"
Lab Sample ID: C08100869-039_043
BKS Sample ID: #153

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

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

A - 0 to 2 inches; yellow (10YR 7/6) sandy loam, brownish yellow (10YR 6/6) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.3); abrupt smooth boundary. (2 to 8 inches thick)

AC - 2 to 5 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; noneffervescent; neutral (pH 7.3); clear smooth boundary. (0 to 7 inches thick)

C - 5 to 16 inches; light brownish gray (10YR 6/2) sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.5); gradual smooth boundary. (8 to 50 inches thick)

Ck1 - 16 to 46 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; violently effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.3); gradual smooth boundary. (0 to 30 inches thick)

Ck2 - 46 to 60 inches; gray (10YR 6/1) sandy clay loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.4).

Type Location - Converse County, Wyoming; refer to waypoint 153 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6

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

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

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

Some pedons have an AC horizon.

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

Range in Characteristics (according to field observations, lab analysis): This profile contains calcic horizons, which are not typical of this series. These calcic horizons are finer in texture than the C horizons are typically for this series.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 16 inches.

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

THEEDLE
SANDY CLAY LOAM

Soil Mapping Unit "Th"
Lab Sample ID: C08100869-044_047
BKS Sample ID: #154

Typical Pedon: Theedle sandy clay loam-on west facing hill footslope of 6 percent; rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 2 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; weak granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (0 to 5 inches thick)

AC - 2 to 7 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (4 to 10 inches thick)

C - 7 to 18 inches; light brownish gray (10YR 6/2) sandy clay, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; noneffervescent, slightly alkaline (pH 7.7); clear smooth boundary.

Ck1 - 18 to 24 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; violently effervescent, calcium carbonate disseminated; moderately alkaline (pH 7.9); clear smooth boundary.

Ck2 - 24 to 36 inches; light reddish brown (2.5YR 7/3) clay, reddish brown (2.5YR 5/3) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; strongly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.0); clear smooth boundary.

Cr - 36 inches; light gray, soft, moderately calcareous shale.

Type Location - Weston County, Wyoming; refer to waypoint 154 on map included in this report.

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): The calcic horizons towards the bottom of the profile are not typical. The textures are finer than typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 24-36 inches. Estimated stripping depth is 12 inches.

Geographic Setting (According to Official Series Description) - Theedle soils are on rock-controlled fan aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hillslope profile but typically are on the lower shoulder, footslope, and toeslope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges

from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

HILAND
SANDY CLAY LOAM

Soil Mapping Unit "Hi"
Lab Sample ID: C08100869-048_053
BKS Sample ID: #155

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

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

A - 0 to 2 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; many very fine and common fine roots; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary. (2 to 5 inches thick)

Bt1 - 2 to 11 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure parting to strong fine and medium angular blocky; hard, friable, moderately sticky and moderately plastic; many very fine roots in a mat at the top of the horizon and common very fine roots between peds; many fine pores; many prominent continuous dark brown (7.5YR 3/3) clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.8); clear wavy boundary.

Bt2 - 11 to 19 inches; light yellowish brown (10YR 6/4) sandy clay loam to sandy clay, yellowish brown (10YR 5/4) moist; strong medium prismatic structure parting to moderate medium subangular blocky; hard, firm, moderately sticky and moderately plastic; common very fine roots between peds; many fine pores; common prominent continuous dark brown (10YR 3/3) clay films on faces of peds and occur as fillings in root channels and pipes; noneffervescent; neutral (pH 7.3); gradual wavy boundary.

BCk - 19 to 26 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; few fine and medium rounded light gray (10YR 7/2) masses of carbonate throughout; violently effervescent; moderately alkaline (pH 8.0); gradual smooth boundary.

Ck - 26 to 37 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to moderate medium and

coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

C1 - 37 to 48 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; moderately effervescent; strongly alkaline (pH 8.7); gradual smooth boundary.

C2 - 48 to 60 inches; light yellowish brown (2.5Y 6/4) coarse sandy clay loam, yellowish brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; slightly effervescent; moderately alkaline (pH 8.1); gradual smooth boundary.

Type Location - Converse County, Wyoming; refer to waypoint 155 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

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

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

The Bt horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. It has a weighted clay content of 20 to 35 percent and is sandy clay

loam; however, parts of this horizon may be sandy loam. This horizon is typically noncalcareous. Reaction is neutral to moderately alkaline.

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

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 7 moist, and chroma of 2 to 4. It is sandy loam, loamy sand, fine sandy loam or sandy clay loam; or, when other textures occur, the horizon average must be sandy loam, loamy sand or fine sandy loam. It is not a calcic horizon. It does not have 5 percent more calcium carbonate equivalent than the underlying horizon or has less than 5 percent secondary carbonates. It is moderately or strongly alkaline. Exchangeable sodium is less than 15 percent even though field tests indicate strongly alkaline reactions.

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

Range in Characteristics (according to field observations, lab analysis): This profile does not have an E horizon, but has 2 C horizons at the bottom, which is not typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal pH (alkaline) was found from 37-48 inches. Estimated stripping depth is 19 inches.

Geographic Setting (According to Official Series Description) - Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

ULM
SANDY CLAY LOAM

Soil Mapping Unit "Ul"
Lab Sample ID: C08100869-054_058
BKS Sample ID: #156

Typical Pedon: Ulm sandy clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 3 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; strong fine granular structure; slightly hard, friable, sticky and plastic; many fine and few medium roots; noneffervescent; neutral (pH 6.6); clear smooth boundary. (2 to 5 inches thick)

Bt1 - 3 to 12 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; noneffervescent; neutral (pH 6.6); clear wavy boundary. (6 to 23 inches thick)

Bt2 - 12 to 29 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; moderately effervescent; slightly alkaline (pH 7.7); clear wavy boundary. (6 to 23 inches thick)

Bn - 29 to 37 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; slightly effervescent; sodium as scattered distinct masses, seams and streaks; slightly alkaline (pH 7.8); clear wavy boundary.

Cn - 37 to 53 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; sodium as scattered distinct masses, seams and streaks; noneffervescent; slightly alkaline (pH 7.6).

Ck - 53 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; calcium carbonate as common distinct masses,

seams and streaks; 5 percent partially weathered shale and sandstone channers; strongly effervescent; slightly alkaline (pH 7.7).

Type Location - Campbell County, Wyoming; refer to waypoint 156 on map included in this report.

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

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

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

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

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

Some pedons have a C horizon.

Range in Characteristics (according to field observations, lab analysis): In this profile, the calcic horizon(s) is found only at the bottom of the profile, which is not typical. Also, natric horizons were found for this profile.

Taxonomic Class - Fine, smectitic, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 12-53 inches. Marginal selenium levels were found from 29-37 inches. Estimated stripping depth is 29 inches.

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

KISHONA
CLAY

Soil Mapping Unit "Ki"
Lab Sample ID: C08100869-059_063
BKS Sample ID: #158

Typical Pedon: Kishona clay-in rangeland. (Colors are for dry soil unless otherwise stated.)

The Kishona series consists of very deep, well drained soils formed in alluvium on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces. Permeability is moderate. Slopes range from 0 to 30 percent. The average annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine roots throughout; noneffervescent; neutral (pH 7.1); clear smooth boundary. (1 to 6 inches thick)

Bw - 2 to 12 inches; very pale brown (10YR 7/3) clay, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; noneffervescent; neutral (pH 7.1); gradual smooth boundary. (0 to 30 inches thick)

BC - 12 to 25 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak, medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; slightly effervescent; slightly alkaline (pH 7.6); gradual smooth boundary.

C1 - 25 to 33 inches; pale brown (10YR 6/3) sandy loam to sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; noneffervescent; moderately alkaline (pH 7.9).

C2 - 33 to 48 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; moderately effervescent; moderately alkaline (pH 8.0).

C3 - 48 to 58 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; noneffervescent; moderately alkaline (pH 8.1).

Cr - 58 inches; moderately calcareous tan and gray sandstone

Type Location - Niobrara County, Wyoming; refer to waypoint 158 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F or more. This soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Some pedons have a thin, noncalcareous Bw horizon that has its base at a depth of less than 10 inches.

The Bk and C horizons have hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 or 5 moist, and chroma of 2 to 4. They are loam, clay loam or silty clay loam and have 20 to 35 percent clay, 20 to 55 percent silt, and 15 to 35 percent fine sand or coarser. Reaction ranges from moderately alkaline to very strongly alkaline. Carbonates in the Bk horizon range from 3 to 14 percent and occur as accumulations in small masses, streaks or seams that decrease with increasing depth, or they are disseminated throughout. The Bk horizon has an EC of 0 to 8 mmhos/cm.

Range in Characteristics (according to field observations, lab analysis): This profile has a BC horizon instead of a calcic horizon. The top of the profile is finer than typical, and the bottom is sandier than typical.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-12 inches. Estimated stripping depth is 48 inches.

Geographic Setting (According to Official Series Description) - Kishona soils are on dissected alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges from 10 to 14 inches with over one-half falling in

April, May and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is about 45 degrees F but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

ZIGWEID
CLAY

Soil Mapping Unit "Zi"
Lab Sample ID: C08100869-064_067
BKS Sample ID: #159

Typical Pedon: Zigweid clay-on a 3 percent southwest facing slope; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Zigweid series consists of very deep, well drained soils formed in alluvium from mixed sedimentary sources on fan aprons, alluvial fans, fan piedmonts, fan remnants, terraces, ridges and hills. Slopes range from 0 to 20 percent. Permeability is moderate. The mean annual precipitation is about 13 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 3 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; slight hard, friable, nonsticky and nonplastic; many very fine and fine roots throughout; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Bw - 3 to 14 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots throughout and few medium throughout; noneffervescent; slightly alkaline (pH 7.4); gradual wavy boundary. (6 to 14 inches thick)

Bk - 14 to 28 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots throughout; common fine irregular light gray (10YR 7/2) carbonate threads throughout; moderately effervescent; moderately alkaline (pH 7.9); gradual wavy boundary.

Ck - 28 to 37 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots throughout; common fine irregular light gray (10YR 7/2) carbonate threads throughout; moderately effervescent; moderately alkaline (pH 8.1).

C - 37 to 60 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots throughout; moderately effervescent; moderately alkaline (pH 8.1).

Type Location - Campbell County, Wyoming; refer to waypoint 159 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to carbonates ranges from 0 to 8 inches. Depth to the Bk horizon and the base of the cambic horizon ranges from 10 to 22 inches. The particle-size control section and soil profile are clay loam or loam. Clay ranges from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with more than 15 percent but less than 35 percent fine sand or coarser. Rock fragments range from 0 to 15 but are typically less than 5 percent and are mostly soft shale chips. The moisture control section is usually dry in all parts for 90 cumulative days following the summer solstice and for 60 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F. The soil temperature at a depth of 20 inches is 41 degrees F or warmer for 175 to 192 days.

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

The Bw horizon has hue of 5Y, 2.5Y or 10YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is loam or clay loam. Reaction is slightly alkaline or moderately alkaline.

The Bk horizon has hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. It is loam or clay loam. It has 5 to 14 percent calcium carbonate equivalent and may have a few scattered crystals of calcium sulfate. Reaction is moderately alkaline or strongly alkaline.

Some pedons have a C horizon with similar properties as the Bk horizon. Some pedons may have sandy clay loam textures below 40 inches. It typically has 3 to 5 percent less calcium carbonate than the overlying Bk horizon.

Range in Characteristics (according to field observations, lab analysis): The upper two feet of the profile have a finer texture than typical.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplocambids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-28 inches. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) - These soils are on fan aprons, alluvial fans, terraces, fan piedmonts, fan remnants, ridges and hills. In many areas they are dissected. Slopes range from 0 to 20 percent. These soils formed in calcareous, moderately fine textured sediments derived from interbedded shale and soft sandstone. Elevations are 3,500 to 6,600 feet. The mean annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than

one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F, and ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

FORKWOOD
CLAY LOAM

Soil Mapping Unit "Fo"
Lab Sample ID: C08100869-068_072
BKS Sample ID: #160

Typical Pedon: Forkwood clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 2 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; slightly alkaline (pH 7.5); abrupt smooth boundary. (1 to 6 inches thick)

Bt1 - 2 to 13 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.5); clear smooth boundary. (6 to 20 inches thick)

Bt2 - 13 to 21 inches; brown (10YR 5/3) clay to clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; moderately effervescent; moderately alkaline (pH 8.1); clear smooth boundary. (6 to 20 inches thick)

Bt3 - 21 to 33 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong medium angular blocky structure; hard, firm, moderately sticky and moderately plastic; few fine and medium roots throughout; few faint clay films on faces of peds; few masses of carbonates; moderately effervescent; moderately alkaline (pH 8.1); clear smooth boundary. (3 to 12 inches thick)

Ck1 - 33 to 55 inches; light brownish gray (2.5Y 6/2) gravelly clay, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots throughout; few masses of carbonates throughout; slightly effervescent; moderately alkaline (pH 8.1). (0 to 40 inches thick)

Ck2 - 55 to 60 inches; light brownish gray (2.5Y 6/2) clay to clay loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots throughout; few masses of carbonates throughout; slightly effervescent; moderately alkaline (pH 8.1). (0 to 40 inches thick)

Type Location - Niobrara County, Wyoming; refer to waypoint 160 on map included in this report.

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

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): The calcic horizons are found as C horizons rather than B or BC horizons. Textures are somewhat finer than typical throughout this profile.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 13-21 inches and 33-60 inches. Estimated stripping depth is 33 inches.

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

FORKWOOD
CLAY LOAM

Soil Mapping Unit "Fo"
Lab Sample ID: C08100869-073_076
BKS Sample ID: #161

Typical Pedon: Forkwood clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 2 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; slightly alkaline (pH 7.7); abrupt smooth boundary. (1 to 6 inches thick)

Bt - 2 to 12 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; noneffervescent; slightly alkaline; (pH 7.7) clear smooth boundary. (6 to 20 inches thick)

Btk - 12 to 28 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; strong medium angular blocky structure; hard, firm, moderately sticky and moderately plastic; few fine and medium roots throughout; few faint clay films on faces of peds; few masses of carbonates; strongly effervescent; slightly alkaline (pH 7.4); clear smooth boundary. (3 to 16 inches thick)

Bn - 28 to 46 inches; light brownish gray (2.5Y 6/2) clay, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and sligtly plastic; few fine roots throughout; many coarse threads and masses of sodium throughout; moderately effervescent; slightly alkaline (pH 7.6); gradual wavy boundary. (9 to 45 inches thick)

BCk - 46 to 51 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots throughout; violently effervescent; slightly alkaline (pH 7.6). (0 to 40 inches thick)

Ck - 51 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine

roots throughout; strongly effervescent; slightly alkaline (pH 7.6). (0 to 40 inches thick)

Type Location - Niobrara County, Wyoming; refer to waypoint 161 on map included in this report.

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

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): The typical calcic horizon is replaced by a natric horizon in this profile. The textures from 12-46 inches are finer than what is typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Magrinal texture (clay) was found from 12-46 inches. Estimated stripping depth is 12 inches.

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

SHINGLE
NONCALCAREOUS VARIANT

Soil Mapping Unit "ShNC"
Lab Sample ID: C08100869_077
BKS Sample ID: #162

Typical Pedon: Shingle clay to clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 5 inches; light brownish gray (10YR 6/2) clay to clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, moderately sticky and moderately plastic; noneffervescent, neutral (pH 7.2); clear smooth boundary. (1 to 6 inches thick)

C - 5 to 12 inches; light yellowish brown (2.5Y 6/3) clay to clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, variable, moderately sticky and moderately plastic; noneffervescent; neutral (pH 7.2); clear wavy boundary. (4 to 15 inches thick)

Cr - 12 inches; soft, slightly to moderately calcareous shale interbedded with lenses of soft sandstone.

Type Location - Goshen County, Wyoming; refer to waypoint 162 on map included in this report.

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

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

0 to 35 percent.

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

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. Textures are slightly finer that what is typical for this series.

Taxonomic Class - Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-12 inches. Estimated stripping depth is 12 inches.

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

KISHONA
CLAY LOAM

Soil Mapping Unit "Ki"
Lab Sample ID: C08100869-078_083
BKS Sample ID: #163

Typical Pedon: Kishona clay to clay loam-in rangeland. (Colors are for dry soil unless otherwise stated.)

The Kishona series consists of very deep, well drained soils formed in alluvium on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces. Permeability is moderate. Slopes range from 0 to 30 percent. The average annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) clay to clay loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine roots throughout; moderately effervescent; slightly alkaline (pH 7.4); clear smooth boundary. (1 to 6 inches thick)

ABk - 2 to 7 inches; brown (10YR 5/3) clay to clay loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine roots throughout; strongly effervescent; slightly alkaline (pH 7.4); clear smooth boundary. (1 to 6 inches thick)

Bk - 7 to 20 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; common fine masses of carbonates; violently effervescent; slightly alkaline (pH 7.8); gradual smooth boundary. (0 to 30 inches thick)

Bkn - 20 to 29 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; many large masses of sodium; common fine masses of carbonates; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary. (0 to 30 inches thick)

BCn - 29 to 37 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; many large masses of sodium; slightly effervescent; moderately alkaline (pH 8.3); gradual smooth boundary. (0 to 30 inches thick)

C1 - 37 to 50 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; scattered moderate masses of sodium; slightly effervescent; moderately alkaline (pH 8.3).

C2 - 50 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; scattered moderate masses of sodium; slightly effervescent; moderately alkaline (pH 8.3).

Type Location - Niobrara County, Wyoming; refer to waypoint 163 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F or more. This soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Some pedons have a thin, noncalcareous Bw horizon that has its base at a depth of less than 10 inches.

The Bk and C horizons have hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 or 5 moist, and chroma of 2 to 4. They are loam, clay loam or silty clay loam and have 20 to 35 percent clay, 20 to 55 percent silt, and 15 to 35 percent fine sand or coarser. Reaction ranges from moderately alkaline to very strongly alkaline. Carbonates in the Bk horizon range from 3 to 14 percent and occur as accumulations in small masses, streaks or seams that decrease with increasing depth, or they are disseminated throughout. The Bk horizon has an EC of 0 to 8 mmhos/cm.

Range in Characteristics (according to field observations, lab analysis): Multiple natric horizons were found, which is not typical of this series. The A horizon has a slightly finer texture than typical.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) –Marginal clay content was found from 0-7 inches. Marginal SAR levels were found from 20-37 inches and unsuitable SAR levels were found from 37-60 inches. Unsuitable EC levels were found from 29-60 inches. Estimated stripping depth is 29 inches.

Geographic Setting (According to Official Series Description) - Kishona soils are on dissected alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges from 10 to 14 inches with over one-half falling in April, May and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is about 45 degrees F but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

TURNERCREST
SANDY CLAY LOAM

Soil Mapping Unit "Tu"
Lab Sample ID: C08100869-084_086
BKS Sample ID: #164

Typical Pedon: Turnercrest sandy clay loam-on a northeast facing hill footslope of 8 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Turnercrest soils consist of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. They are on bedrock-controlled hills, fan remnants, ridges and structural benches. Slopes range from 0 to 30 percent. The average annual precipitation is about 12, and the mean annual air temperature is about 47 degrees F.

A - 0 to 3 inches; brown (10YR 5/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine and very fine roots; noneffervescent; neutral (pH 7.3); clear smooth boundary. (2 to 6 inches thick)

Bw - 3 to 10 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; soft, friable; common fine and very fine roots; noneffervescent; neutral (pH 7.3); gradual smooth boundary. (0 to 8 inches thick)

Ck1 - 10 to 20 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; soft, friable; common fine and very fine roots; strongly effervescent; carbonates occurs in filaments and few masses; moderately alkaline (pH 7.9); gradual smooth boundary.

Ck2 - 20 to 34 inches; light gray (10YR 7/2) gravelly clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots to 15 inches; strongly effervescent; carbonates disseminated and as few fine filaments; moderately alkaline (pH 8.0); clear wavy boundary.

C - 34 to 38 inches; light gray (10YR 7/2) gravelly clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots to 15 inches; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Cr - 38 inches; soft, light gray and very pale brown, noncalcareous sandstone.

Type Location - Weston County, Wyoming; refer to waypoint 164 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, calcareous sandstone ranges from 20 to 40 inches. These soils are typically calcareous throughout but may be leached as much as to 6 inches in some pedons. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F or warmer and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle-size control section is fine sandy loam or sandy loam with 7 to 18 percent clay and 52 to 80 percent sand with more than 15 percent being fine sand or coarser. EC is 0 to 2 mmhos throughout the soil. Rock fragments may be present but break down on pretreatment and do not have lithic properties.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 and 3 to 5 moist, and chroma of 2 to 4. Textures are loamy sand, loamy fine sand, fine sandy loam or sandy loam. Reaction is neutral to moderately alkaline.

The Bw horizon, where present, has hue of 10YR or 2.5Y, value of 5 or 6 and 3 to 5 moist, and chroma of 2 or 3. Depth to the base of the Bw horizon is less than 10 inches. Texture is fine sandy loam or sandy loam. Reaction is slightly alkaline or moderately alkaline.

The Bk has hue of 10YR or 2.5Y, value of 5 to 7 and 3 to 6 moist, and chroma of 2 or 3. Texture is fine sandy loam, very fine sandy loam or sandy loam. Reaction is slightly or moderately alkaline.

The C horizon, when present, has hue of 10YR or 2.5Y, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 4. Texture is fine sandy loam, very fine sandy loam or sandy loam. Some pedons have thin layers of loamy fine sand. Reaction is slightly alkaline or moderately alkaline.

The Cr horizon has a paralithic contact to soft, calcareous sandstone. The sandstone has hue of 10YR or 2.5Y.

Range in Characteristics (according to field observations, lab analysis): Textures are much finer than those typical of this series.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 38 inches.

Geographic Setting (According to Official Series Description) - Turnercrest soils are on hills, ridges, fan remnants and structural benches. They formed in eolian or alluvium deposits and sandy residuum. Slopes are 0 to 30 percent. Elevations are 3,200 to 6,500 feet. The average annual precipitation is 10 to 15 inches with over half falling as snow or rain in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 45 to 53 degrees F. The frost-free season is 105 to 130 days.

KISHONA
CLAY LOAM

Soil Mapping Unit "Ki"
Lab Sample ID: C08100869-087_091
BKS Sample ID: #165

Typical Pedon: Kishona sandy clay loam-in rangeland. (Colors are for dry soil unless otherwise stated.)

The Kishona series consists of very deep, well drained soils formed in alluvium on fan aprons, alluvial fans, fan remnants, hills, ridges and terraces. Permeability is moderate. Slopes range from 0 to 30 percent. The average annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine roots throughout; strongly effervescent; moderately alkaline (pH 7.9); clear smooth boundary. (1 to 6 inches thick)

Bk1 - 2 to 17 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; common fine masses of carbonates; violently effervescent; moderately alkaline (pH 7.9); gradual smooth boundary. (0 to 30 inches thick)

Bk2 - 17 to 27 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak medium and coarse angular structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots throughout; common fine masses of carbonates; strongly effervescent; moderately alkaline (pH 8.4); gradual smooth boundary. (0 to 30 inches thick)

C - 27 to 36 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; moderately effervescent; moderately alkaline (pH 8.4).

Cn - 36 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slight sticky and nonplastic; few very fine roots throughout; few small masses of sodium; slightly effervescent; moderately alkaline (pH 8.2).

Type Location - Niobrara County, Wyoming; refer to waypoint 165 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F or more. This soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Some pedons have a thin, noncalcareous Bw horizon that has its base at a depth of less than 10 inches.

The Bk and C horizons have hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 or 5 moist, and chroma of 2 to 4. They are loam, clay loam or silty clay loam and have 20 to 35 percent clay, 20 to 55 percent silt, and 15 to 35 percent fine sand or coarser. Reaction ranges from moderately alkaline to very strongly alkaline. Carbonates in the Bk horizon range from 3 to 14 percent and occur as accumulations in small masses, streaks or seams that decrease with increasing depth, or they are disseminated throughout. The Bk horizon has an EC of 0 to 8 mmhos/cm.

Range in Characteristics (according to field observations, lab analysis): A natric horizon was found at the bottom of the profile, which is not typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 36 inches.

Geographic Setting (According to Official Series Description) - Kishona soils are on dissected alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges from 10 to 14 inches with over one-half falling in April, May and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is about 45 degrees F but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

DWYER
LOAMY SAND

Soil Mapping Unit "Dw"
Lab Sample ID: C08100869-092_095
BKS Sample ID: #166

Typical Pedon: Dwyer loamy sand-grassland. (Colors are for dry soil unless otherwise stated.)

The Dwyer series consists of very deep, excessively drained soils that formed in eolian sand. Dwyer soils are on dune-like forms frequently on or near the edges of alluvial terraces and have slopes of 0 to 25 percent. The mean annual precipitation is about 14 inches, and the mean annual temperature is about 48 degrees F.

A - 0 to 2 inches; pale brown (10YR 6/3) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; noneffervescent; slightly alkaline (pH 7.6); gradual smooth boundary. (2 to 8 inches thick)

C1 - 2 to 7 inches; very pale brown (10YR 7/3) loamy sand, grayish brown (10YR 5/2) moist; single grain; loose; noneffervescent; slightly alkaline (pH 7.6).

C2 - 7 to 13 inches; very pale brown (10YR 7/3) sandy loam, grayish brown (10YR 5/2) moist; single grain; loose; moderately effervescent; moderately alkaline (pH 7.9).

Ck1 - 13 to 21 inches; very pale brown (10YR 7/3) sandy loam, grayish brown (10YR 5/2) moist; single grain; loose; strongly effervescent; moderately alkaline (pH 7.9).

Ck2 - 21 to 36 inches; very pale brown (10YR 7/3) very gravelly very fine sandy loam, grayish brown (10YR 5/2) moist; single grain; loose; violently effervescent; moderately alkaline (pH 8.2).

Ck3 - 36 to 48 inches; very pale brown (10YR 7/3) very gravelly loamy very fine sand, grayish brown (10YR 5/2) moist; single grain; loose; strongly effervescent; slightly alkaline (pH 7.8).

Cr - 48 inches; tan sandstone

Type Location - Goshen County, Wyoming; refer to waypoint 166 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) –
Typically, this soil is calcareous throughout but is leached in the upper part of the series control section in some pedons.

The control section is sand, loamy sand, fine sand, or loamy fine sand.

Coarse fragments range from 0 to 15 percent but are commonly less than 3 percent. These soils may have a weak and inconsistent accumulation of secondary calcium carbonate at any depth but are not considered to have a continuous Bk horizon.

The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. Bedrock is deeper than 60 inches.

A horizon :
Hue: 2.5Y or 10YR
Value: 5 through 7 dry, 3 through 5 moist
Chroma: 2 or 3
Texture: Fine sand, loamy fine sand or loamy sand
Clay content: 2-10 percent
Sand content: greater than 80 percent
Reaction: mildly alkaline through strongly alkaline but is slightly acid or neutral in some pedons

AC horizon:
Texture: loamy fine sand or fine sand is in some pedon.

C horizon
Hue: 2.5Y through 7.5YR
Value: 5 through 7 dry, 3 through 5 moist
Chroma:2 through 4
Texture: Fine sand or loamy fine sand
Clay content: 2-10 percent
Sand content: greater than 80 percent
Reaction: moderately alkaline or strongly alkaline and may contain few small carbonate concretions or seams of calcium carbonate erratically at any depth

Range in Characteristics (according to field observations, lab analysis): Multiple calcic horizons were found towards the bottom of this profile, which is not typical of this series.

Taxonomic Class - Mixed, mesic Ustic Torripsamments

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal from 0-7 inches and 21-48 inches. Estimated stripping depth is 48 inches.

Geographic Setting (According to Official Series Description) –
Landscape: terraces and rolling uplands
Landform: hill slopes and dune-like forms frequently on or near the edges of alluvial terraces
Slopes: irregular, ranging from 0 to 25 percent
Elevation: 3,500 to 5,600 feet
Parent material: eolian sand
Average annual precipitation: 14 inches with about half of the precipitation occurring in April, May, and June
Mean annual precipitation: 10 to 16 inches
Mean annual temperature: 48 degrees F, and the mean summer temperature is 68 degrees F
Frost-free season: 110 to 130 day.

CLARKELEN
NONCALCAREOUS VARIANT

Soil Mapping Unit "ClNC"
Lab Sample ID: C08100869-096_100
BKS Sample ID: #168

Typical Pedon: Clarkelen loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Clarkelen series consists of very deep, well, moderately well or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. Clarkelen soils are on flood plains and terraces. Slopes range from 0 to 6 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 4 inch; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; slightly acid (pH 6.2); gradual smooth boundary. (1 to 6 inches thick)

AC - 4 to 9 inch; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; slightly acid (pH 6.2); gradual smooth boundary.

C1 - 9 to 29 inches; light brownish gray (10YR 6/2) weakly stratified loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; soft, very friable, nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; neutral (pH 6.6); abrupt wavy boundary.

C2 - 29 to 41 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) stratified loam, grayish brown (10YR 5/2) moist; massive; thin stratifications; slight hard, friable, nonsticky and nonplastic; few fine and very fine roots; noneffervescent; neutral (pH 6.9); abrupt wavy boundary.

C3 - 41 to 51 inches; light brownish gray (10YR 6/2) sandy loam to sandy clay loam, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; noneffervescent; neutral (pH 7.0); abrupt smooth boundary.

C4 - 51 to 60 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; slightly hard, friable, nonsticky and nonplastic; few fine roots; noneffervescent; neutral (pH 7.0).

Type Location - Niobrara County, Wyoming; refer to waypoint 168 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) – This soil typically lacks horizons of continuous carbonate accumulation. Depth to carbonates ranges from 0 to 8 inches. Rock fragments are typically less than 5 percent but may range to 15 percent. Organic matter content decreases irregularly with depth; and thin, highly variable textural strata usually occur between 6 and 24 inches. The particle-size control section contains from 5 to 18 percent clay and is sandy loam, fine sandy loam or loam when averaged. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 4. Texture typically is sandy loam or fine sandy loam but may range from loamy sand to clay loam depending upon the most recent deposition. Reaction ranges from neutral to moderately alkaline. It has an EC of 0 to 4 mmhos/cm. Nitrogen and phosphorus levels are not abnormally enriched. Some pedons have an AC horizon up to 8 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture centers on sandy loam, fine sandy loam or loam, but strata of very fine sandy loam, loam, silt loam, loamy fine sand, loamy sand, fine sand or sand of varying thickness occur. Skeletal material may occur below 40 inches in some pedons. Reaction ranges from slightly alkaline to strongly alkaline. EC is typically 4 mmhos/cm or less but may range up to 8 when irrigated or where it receives saline discharge from surrounding shale beds.

Range in Characteristics (according to field observations, lab analysis): The pH is acidic rather than neutral or alkaline for the A and AC horizons and neutral instead of alkaline for the C horizons.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) – Clarkelen soils are on flood plains and terraces adjacent to floodplains. Slopes are 0 to 6 percent. The soils formed in stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock. Elevation is 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

CAMBRIA
SANDY CLAY LOAM

Soil Mapping Unit "Ca"
Lab Sample ID: C08100869-101_104
BKS Sample ID: #170

Typical Pedon: Cambria sandy clay loam on rangeland. (Colors are for dry soil unless otherwise stated.)

The Cambria series consists of very deep, well drained, moderately permeable soils that formed in alluvium and slope alluvium on fan remnants, alluvial fans, fan piedmonts, terraces, ridges and hills. Slopes range from 0 to 15 percent and are usually simple but may be complex where the area has been dissected by ephemeral streams. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 45 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) extremely gravelly sandy clay loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; noneffervescent; neutral (pH 6.9); clear smooth boundary. (2 to 5 inches thick)

Bt - 2 to 9 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; common distinct dark brown (10YR 3/3) clay films on faces of peds; noneffervescent; neutral (pH 6.9); clear wavy boundary. (5 to 8 inches thick)

Bk - 9 to 29 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; common fine irregular light gray (10YR 7/2) carbonate threads throughout; slightly alkaline (pH 7.8); gradual wavy boundary.

C - 29 to 40 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; moderately effervescent; moderately alkaline (pH 8.1).

Cn - 40 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; slightly effervescent; scattered small sodium masses throughout; moderately alkaline (pH 7.9).

Type Location - Campbell County, Wyoming; refer to waypoint 170 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) –
Soil moisture: The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 48 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

Depth to the base of the argillic horizon: 10 inches or less
Depth to secondary calcium carbonate: 3 to 10 inches but ranges to 15 inches in some pedons
Particle-size control section: It is loam, clay loam, silty clay loam or sandy clay loam. The part below the argillic horizon averages 18 to 35 percent clay, 10 to 50 percent silt, and 20 to 70 percent sand with more than 15 but less than 52 percent coarser than very fine sand.

A horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4 dry or moist
Texture: fine sandy loam, sandy loam, loam, very fine sandy loam or silt loam
Reaction: typically neutral or slightly alkaline but may be moderately alkaline in some pedons

Some pedons have an AB horizon up to 4 inches thick.

Bt horizon:
Hue: 7.5YR, 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4 dry or moist
Texture: loam, clay loam, silty clay loam or sandy clay loam
Reaction: neutral to moderately alkaline

A thin Btk horizon may be present above the Bk horizon in some pedons and have properties of both the Bt and Bk.

Bk horizon:
Hue: 10YR or 2.5Y
Value: 5 to 8 dry, 4 to 6 moist
Chroma: 2 to 4 dry or moist
Texture: typically loam or clay loam but some subhorizons have sandy loam, fine sandy

loam, very fine sandy loam, silt loam, silty clay loam or sandy clay loam strata
Calcium carbonate equivalent: averages less than 15 percent, but discontinuous strata may exceed 15 percent in some pedons

Reaction: moderately or strongly alkaline with less than 15 percent ESP

Some pedons have a C horizon

Range in Characteristics (according to field observations, lab analysis): A natric horizon was identified for this profile, which is not typical of this series. The A horizon has a finer texture than what is typical.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameter were found for this profile. Estimated stripping depth is 9 inches.

Geographic Setting (According to Official Series Description) –
Parent material: alluvium and slope alluvium from mixed sources
Landform: fan remnants, fan piedmonts, alluvial fans, hills, ridges and terraces
Slopes: 0 to 15 percent
Elevations: 3,500 to 6,500 feet
Average annual precipitation: 10 to 14 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October
Mean annual air temperature: 43 to 51 degrees F
Frost-free season: 105 to 130 days

SHINGLE
CLAY LOAM

Soil Mapping Unit "Sh"
Lab Sample ID: C08100869-105
BKS Sample ID: #171

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

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

A - 0 to 3 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, moderately sticky and moderately plastic; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (1 to 6 inches thick)

Ck - 3 to 7 inches; light yellowish brown (2.5Y 6/3) heavy clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, variable, moderately sticky and moderately plastic; strongly effervescent, lime disseminated; slightly alkaline (pH 7.6); clear wavy boundary. (4 to 15 inches thick)

Cr - 7 inches; soft, strongly calcareous shale interbedded with lenses of soft sandstone

Type Location - Goshen County, Wyoming; refer to waypoint 171 on map included in this report.

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

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

0 to 35 percent.

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

Range in Characteristics (according to field observations, lab analysis): There is a calcic horizon found at the bottom of the profile, which is not typical for this series.

Taxonomic Class - Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. The estimated stripping depth is 7 inches.

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

EMBRY
MODERATELY DEEP VARIANT

Soil Mapping Unit "EmMV"
Lab Sample ID: C08100869-106_108
BKS Sample ID: #172

Typical Pedon: Embry sandy clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The soils of the Embry series are very deep, well-drained soils formed in alluvium and eolian deposits derived from sandstone. They are on hills, dunes, terraces and alluvial fans. Slopes are 0 to 20 percent. The mean annual precipitation is about 12 inches and the mean annual air temperature is about 46 degrees F.

A - 0 to 4 inches; light brownish gray (10YR 6/2) fine sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.1); clear smooth boundary. (4 to 16 inches thick)

AC - 4 to 12 inches; light brownish gray (10YR 6/2) fine sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.1); clear smooth boundary.

C1 - 12 to 19 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine vesicular pores; noneffervescent; slightly alkaline (pH 7.5); gradual wavy boundary.

C2 - 19 to 29 inches; pale brown (10YR 6/3) coarse sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.6).

Cr - 29 inches; strongly calcareous mixed gley shale.

Type Location - Johnson County, Wyoming; refer to waypoint 172 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - These soils are typically noncalcareous throughout, however some pedons may effervesce below a depth of 40 inches. Rock fragments range from 0 to 15 percent but are typically less than 5 percent and are mainly gravel size sandstone fragments. The control section is typically sandy loam but clay ranges from 5 to 18 percent, silt from 5 to 40 percent, and sand from 50 to 83 percent with more than 35 percent fine sand or coarser. The moisture control

section is dry for 60 consecutive days and 90 cumulative days between July 15 and October 25. The mean annual soil temperature ranges from 47 degrees to 53 degrees F.

The A horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 1 to 4. This horizon is slightly acid to slightly alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is sandy loam or fine sandy loam. It is slightly acid to moderately alkaline.

Range in Characteristics (according to field observations, lab analysis): This profile is moderately deep to paralithic material, rather than deep.

Taxonomic Class - Coarse-loamy, mixed, superactive, nonacid, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal at 0-19 inches. Estimated stripping depth is 19 inches.

Geographic Setting (According to Official Series Description) - Embry soils are on alluvial fans, hills, dunes and terraces. Slopes are 0 to 20 percent. Elevation is 4200 to 6000 feet. These soils formed in alluvium and eolian deposits derived from noncalcareous sandstone. Annual precipitation ranges from 10 to 15 inches most of which falls as rain or snow in April, May, and June. The mean annual air temperature is 45 to 50 degrees F. The frost-free period is 110 to 130 days.

KEELINE
SANDY CLAY LOAM

Soil Mapping Unit "Ke"
Lab Sample ID: C08100869-109_113
BKS Sample ID: #173

Typical Pedon: Keeline sandy clay loam-on east facing shoulder slope of 4 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

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

Ck1 - 2 to 15 inches; very pale brown (10YR 7/3) sandy clay loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated; slightly alkaline (pH 7.6); gradual smooth boundary. (8 to 50 inches thick)

Ck2 - 15 to 31 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; moderately effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.0); gradual smooth boundary. (0 to 25 inches thick)

C1 - 31 to 37 inches; very pale brown (10YR 7/3) sandy loam to sandy clay loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; slightly effervescent; moderately alkaline (pH 7.9).

C2 - 37 to 55 inches; very pale brown (10YR 7/3) coarse sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.8).

C3 - 55 to 60 inches; very pale brown (10YR 7/3) loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.2).

Type Location - Converse County, Wyoming; refer to waypoint 173 on map included in this report.

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

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

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

Some pedons have an AC horizon.

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

Range in Characteristics (according to field observations, lab analysis): Two calcic horizons were identified for this profile, which is not typical of this series. Slightly finer textures were found from 0 to 37 inches in this profile.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) - Keeline soils are on terraces, benches, alluvial fans, fan remnants, ridgetop and hillslope positions. Slopes are 0 to 40 percent. These soils formed in moderately coarse alluvium or eolian deposits derived from calcareous sandstone. Elevations are 3,500 to 6,200 feet. The average

annual precipitation is 12 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 15 inches. The mean annual temperature is about 46 degrees F but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

BAHL
CLAY LOAM

Soil Mapping Unit "Ba"
Lab Sample ID: C08100869-114_118
BKS Sample ID: #174

Typical Pedon: Bahl clay loam-on north-facing terrace with slope of 3 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Bahl series consists of very deep, well drained soils formed on alluvial fans, fan aprons, hillslopes, and terraces in alluvium from clay shales. Slopes range from 0 to 20 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 3 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak angular blocky structure; very hard, very firm, very sticky and plastic; common fine and medium roots; noneffervescent; neutral (pH 7.1); clear wavy boundary. (3 to 6 inches thick)

AB - 3 to 10 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak angular blocky structure; very hard, very firm, very sticky and plastic; common fine and medium roots; moderately effervescent; slightly alkaline (pH 7.5); clear wavy boundary.

Bk - 10 to 20 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak angular blocky structure; very hard, very firm, very sticky and plastic; few fine and medium roots; strongly effervescent, calcium carbonate is disseminated; slightly alkaline (pH 7.8); gradual wavy boundary (4 to 15 inches thick).

Cn1 - 20 to 36 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, very sticky and plastic; few fine roots; noneffervescent, sodium is disseminated; slightly alkaline (pH 7.6).

Cn2 - 36 to 48 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, very sticky and plastic; few fine roots; noneffervescent, sodium is disseminated; slightly alkaline (pH 7.6).

Type Location - Weston County, Wyoming; refer to waypoint 132 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - The soil is usually calcareous throughout but is noncalcareous in the upper few inches of some pedons. The particle size control section is clay or clay loam with 35 to 55 percent clay.

Deep, wide cracks are present and are open for 6 to 8 months. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR through 5Y, value of 5 through 7 dry, 3 through 5 moist, and chroma of 2 or 3. Texture is clay loam or clay, and clay ranges form 30 to 45 percent. EC ranges from 0 to 2 mmhos. Reaction is neutral through moderately alkaline.

The AC horizon, has the same ranges as allowed for the combined ranges of the A and C horizons. A Bw may be present in some pedons but does not meet the criteria for a cambic horizon.

Some pedons have a Bk horizon, that is not a calcic horizon, with properties similar to the C horizon. Pedons with Bk horizons may have an AB horizon with properties similar to the A and Bk horizons.

The C horizon has hue of 10YR through 5Y, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is typically clay but may be clay loam, and clay ranges from 35 to 55 percent. EC ranges from 2 to 4 mmhos. Reaction is slightly alkaline through strongly alkaline.

Range in Characteristics (according to field observations, lab analysis): Two natric C horizons were found in this profile, in place of one normal C horizon.

Taxonomic Class - Fine, smectitic, calcareous, mesic Ustertic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 3-36 inches. Selenium levels were marginal from 36-48 inches. Estimated stripping depth is 10 inches.

Geographic Setting (According to Official Series Description) - Bahl soils are on alluvial fans, fan aprons, hillslopes, and terraces. Slopes are simple and range from 0 to 20 percent. The soils formed in alluvium from clay shales. Elevation is 3,500 to 5,000 feet. The average annual precipitation is 10 to 17 inches of which about half falls in April, May, and June. The average annual temperature is 43 to 51 degrees F. The frost-free season is about 110 to 130 days.

HILAND
NONCALCAREOUS VARIANT

Soil Mapping Unit "HiNC"
Lab Sample ID: C08100869-119_123
BKS Sample ID: #175

Typical Pedon: Hiland sand-on northeast facing slope of 3 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 4 inches; brown (10YR 5/3) sand, brown (10YR 4/3) moist; weak medium granular structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; many very fine and common fine roots; noneffervescent; neutral (pH 6.7); abrupt smooth boundary. (2 to 5 inches thick)

Bt1 - 4 to 17 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; strong medium prismatic structure parting to strong fine and medium angular blocky; hard, friable, moderately sticky and moderately plastic; many very fine roots in a mat at the top of the horizon and common very fine roots between peds; many fine pores; many prominent continuous dark brown (7.5YR 3/3) clay films on faces of peds; noneffervescent; neutral (pH 6.9); clear wavy boundary.

Bt2 - 17 to 33 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure parting to moderate medium subangular blocky; hard, firm, moderately sticky and moderately plastic; common very fine roots between peds; many fine pores; common prominent continuous dark brown (10YR 3/3) clay films on faces of peds and occur as fillings in root channels and pipes; noneffervescent; neutral (pH 7.3); gradual wavy boundary.

C1 - 33 to 41 inches; light yellowish brown (2.5Y 6/3) sandy loam to sandy clay loam, light olive brown (2.5Y 5/3) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; noneffervescent; slightly alkaline (pH 7.7); gradual smooth boundary.

C2 - 41 to 48 inches; light yellowish brown (2.5Y 6/3) sandy clay loam, light olive brown (2.5Y 5/3) moist; common fine and medium distinct yellowish brown (10YR 5/6) and common fine light brownish gray (10YR 6/2) relic redoximorphic features; weak coarse

prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many fine pores; noneffervescent; moderately alkaline (pH 8.0); gradual smooth boundary.

Type Location - Converse County, Wyoming; refer to waypoint 133 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

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

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

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

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

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 7 moist, and chroma of 2 to 4. It is sandy loam, loamy sand, fine sandy loam or sandy clay loam; or, when other textures occur, the horizon average must be sandy loam, loamy sand or fine sandy loam. It is not a calcic horizon. It does not have 5 percent more calcium carbonate equivalent than the underlying horizon or has less than 5 percent secondary carbonates. It is moderately or strongly alkaline. Exchangeable sodium is less than 15 percent even though field tests indicate strongly alkaline reactions.

Some pedons have a 2Bk, 2C or C horizon. The 2C and 2Bk horizons may contain more rock fragments. Contrasting textures of sand may occur below 40 inches. It is calcareous but typically has less than 5 percent calcium carbonate equivalent.
Range in Characteristics (according to field observations, lab analysis): Profile is noncalcareous throughout. There was no E horizon identified in this profile. Two C horizons were found in place of the calcic B horizon at the bottom of the profile. The A horizon is sandier than what is typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (sand) was found from 0-4 inches. Saturation percentage was marginal from 0-4 inches. Estimated stripping depth is 41 inches.

Geographic Setting (According to Official Series Description) - Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

WORF
NONCALCAREOUS VARIANT

Soil Mapping Unit "WoNC"
Lab Sample ID: C08100869-124_125
BKS Sample ID: #177

Typical Pedon: Worf sandy loam to sandy clay loam- rangeland. (Colors are for dry soil unless otherwise stated.)

The Worf series consists of well drained soils that are very shallow or shallow to bedrock. They formed in residuum and colluvial slopewash weathered from sedimentary rock. Worf soils are on upland hills and ridges and have slopes of 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 45 degrees F.

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

Bt - 2 to 15 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, very friable, moderately sticky and moderately plastic; many fine roots; many distinct clay films on faces of peds, common faint clay films in root channels and pores; noneffervescent; neutral (pH 6.8); clear wavy boundary. (4 to 13 inches thick)

Cr - 15 inches; noncalcareous sandstone interbedded with loamstone.

Type Location - Johnson County, Wyoming; refer to waypoint 21 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to bedrock ranges from 8 to 20 inches. The soil is 90 to 100 percent base saturated. Rock fragments range from 0 to 15 percent but are typically less than 5 percent and are mostly soft shale fragments. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry, 3 or 4 moist, and chroma of 2 or 3. Texture is loamy sand, loam, or fine sandy loam. Reaction is neutral or slightly

alkaline.

The Bt horizon has hue of 2.5Y through 7.5YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 through 4. It is typically light clay loam but may be loam or sandy clay loam with clay ranging from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with 15 to 35 percent being fine sand or coarser. Reaction is neutral to moderately alkaline.

The Bk or Btk horizon has hue of 5Y through 10YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Calcium carbonate equivalent is 3 to 12 percent. Texture is loam or fine sandy loam in the Bk and clay loam or sandy clay loam in the Btk. Reaction is slightly alkaline through strongly alkaline.

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. No calcic horizon was found for this profile, which is not typical of this series.

Taxonomic Class - Loamy, mixed, superactive, mesic, shallow Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 12 inches.

Geographic Setting (According to Official Series Description) - These soils are on upland hills and ridges. Slopes range from 0 to 30 percent and are both simple and complex. Elevation is 3,500 to 5,600 feet. These soils formed in noncalcareous materials weathered from sedimentary bedrock. The mean annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 17 inches. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

DRAKNAB
SANDY LOAM

Soil Mapping Unit "Dr"
Lab Sample ID: C08100869-126_131
BKS Sample ID: #178

Typical Pedon: Draknab sandy loam-on an east facing, very gentle sloping flood plain; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Draknab series consists of very deep, moderately well, well or excessively drained soils formed in stratified recent stream alluvium. Draknab soils are on flood plains and on adjacent low terrace positions. Slopes range from 0 to 6 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 2 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak medium and fine granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 6.8); abrupt smooth boundary. (2 to 6 inches thick)

AC - 2 to 12 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak medium granular; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.2); clear wavy boundary. (0 to 10 inches thick)

C1 - 12 to 18 inches; very pale brown (10YR 7/3) sandy loam, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky and nonplastic; noneffervescent; neutral (pH 7.2); clear wavy boundary. (6 to 15 inches thick)

C2 - 18 to 29 inches; pale brown, coarse sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.7); gradual smooth boundary. (0 to 24 inches thick)

C3 - 29 to 35 inches; very pale brown (10YR 7/3), stratified sandy loam, pale brown (10YR 6/3) moist; single grain; loose, nonsticky and nonplastic; noneffervescent; neutral (pH 7.0).

C4 - 35 to 60 inches; very pale brown (10YR 7/3), stratified sandy loam, pale brown (10YR 6/3) moist; single grain; loose, nonsticky and nonplastic; moderately effervescent; moderately alkaline (pH 8.0).

Type Location - Converse County, Wyoming; refer to waypoint 40 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Carbonates occur throughout the profile, but the surface to depths of 10 inches may be free of carbonates, depending upon the source material of the most recent deposition. Organic matter content decreases irregularly with depth. Thin, highly variable textural strata usually occur between depths of 10 and 30 inches. Rock fragments are gravel size and typically are less than 5 percent throughout the profile, but may range to 15 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 4 mmhos/cm throughout the soil.

The A horizon has hue of 2.5Y, 10YR or 7.5YR, value of 5 to 7 and 3 to 6 moist, and chroma of 2 to 4. Texture is loamy sand, sandy loam, loamy fine sand, fine sandy loam, very fine sandy loam or loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5Y, 10YR or 7.5YR, value of 5 to 7 and 4 to 7 moist, and chroma of 2 to 4. Texture is loamy sand, loamy coarse sand, coarse sand, loamy fine sand or sand. Many pedons have stratification of varying thickness and texture, very fine sandy loam and sandy loam being the more common. Reaction ranges from slightly alkaline to strongly alkaline.

Range in Characteristics (according to field observations, lab analysis): This profile contains a horizon at 18-29 inches with a higher clay % than what is typical for this series.

Taxonomic Class - Sandy, mixed, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal from 2-18 inches and 29-60 inches. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) - Draknab soils are on flood plains and low terraces adjacent to flood plains. Slopes are 0 to 6 percent. The soils formed in coarse textured recent stream alluvium derived originally from sandstone-dominated sedimentary rock. Elevations are 3,500 to 6,000 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F, but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

THEEDLE
CLAY

Soil Mapping Unit "Th"
Lab Sample ID: C08100869-132_135
BKS Sample ID: #180

Typical Pedon: Theedle clay -on west facing hill footslope of 6 percent; rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 2 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; weak granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; noneffervescent; moderately alkaline (pH 8.1); clear smooth boundary. (0 to 5 inches thick)

AC - 2 to 12 inches; light brownish gray (2.5Y 6/2) clay to clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; noneffervescent; neutral (pH 6.8); clear smooth boundary. (4 to 10 inches thick)

C1 - 12 to 19 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; noneffervescent; neutral (pH 6.8); clear smooth boundary.

C2 - 19 to 37 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; moderately effervescent; neutral (pH 7.2); clear smooth boundary. (14 to 26 inches thick)

Cr - 37 inches; light gray, soft, noncalcareous sandstone.

Type Location - Weston County, Wyoming; refer to waypoint 41 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, gray, calcareous sandstone or sandy shale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the

time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

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

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

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

Range in Characteristics (according to field observations, lab analysis): Higher clay %'s are found from 0-12 inches in this profile than what is typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-12 inches. Estimated stripping depth is 37 inches.

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

TURNERCREST
NONCALCAREOUS VARIANT

Soil Mapping Unit "Tu"
Lab Sample ID: C08100869-136_138
BKS Sample ID: #181

Typical Pedon: Turnercrest sandy clay loam-on a northeast facing hill footslope of 8 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Turnercrest soils consist of moderately deep, well drained soils formed in eolian or alluvium deposits and residuum derived from soft sandstone. They are on bedrock-controlled hills, fan remnants, ridges and structural benches. Slopes range from 0 to 30 percent. The average annual precipitation is about 12, and the mean annual air temperature is about 47 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine and very fine roots; noneffervescent; neutral (pH 6.7); clear smooth boundary. (2 to 6 inches thick)

Bw - 2 to 9 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; soft, friable; common fine and very fine roots; noneffervescent; neutral (pH 6.8); gradual smooth boundary. (0 to 8 inches thick)

C1 - 9 to 16 inches; light gray (10YR 7/2) sandy loam to sandy clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots to 15 inches; noneffervescent; neutral (pH 7.2); clear wavy boundary.

C2 - 16 to 21 inches; light gray (10YR 7/2) sandy loam to sandy clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots to 15 inches; noneffervescent; neutral (pH 7.2); clear wavy boundary.

Cr - 21 inches; soft, light gray and very pale brown, strongly calcareous sandstone.

Type Location - Weston County, Wyoming; refer to waypoint 43 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, calcareous sandstone ranges from 20 to 40 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F or warmer and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The

particle-size control section is fine sandy loam or sandy loam with 7 to 18 percent clay and 52 to 80 percent sand with more than 15 percent being fine sand or coarser. EC is 0 to 2 mmhos throughout the soil. Rock fragments may be present but break down on pretreatment and do not have lithic properties.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 and 3 to 5 moist, and chroma of 2 to 4. Textures are loamy sand, loamy fine sand, fine sandy loam or sandy loam. Reaction is neutral to moderately alkaline.

The Bw horizon, where present, has hue of 10YR or 2.5Y, value of 5 or 6 and 3 to 5 moist, and chroma of 2 or 3. Depth to the base of the Bw horizon is less than 10 inches. Texture is fine sandy loam or sandy loam. Reaction is slightly alkaline or moderately alkaline.

The Bk has hue of 10YR or 2.5Y, value of 5 to 7 and 3 to 6 moist, and chroma of 2 or 3. Texture is fine sandy loam, very fine sandy loam or sandy loam. Reaction is slightly or moderately alkaline.

The C horizon, when present, has hue of 10YR or 2.5Y, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 4. Texture is fine sandy loam, very fine sandy loam or sandy loam. Some pedons have thin layers of loamy fine sand. Reaction is slightly alkaline or moderately alkaline.

The Cr horizon has a paralithic contact to soft, calcareous sandstone. The sandstone has hue of 10YR or 2.5Y.

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. No calcic horizons are found in this profile, which is not typical. The A and C horizons in this profile have a higher clay % than what is typical of this series.

Taxonomic Class - Coarse-loamy, mixed, superactive, noncalcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 21 inches.

Geographic Setting (According to Official Series Description) - Turnercrest soils are on hills, ridges, fan remnants and structural benches. They formed in eolian or alluvium deposits and sandy residuum. Slopes are 0 to 30 percent. Elevations are 3,200 to 6,500 feet. The average annual precipitation is 10 to 15 inches with over half falling as snow or rain in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 45 to 53 degrees F. The frost-free season is 105 to 130 days.

ORPHA
SANDY LOAM

Soil Mapping Unit "Or"
Lab Sample ID: C08100869-139_142
BKS Sample ID: #182

Typical Pedon: Orpha sandy loam-on a west facing dune slope of 6 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Orpha series consists of very deep, excessively drained soils on rolling dunes, hills, terraces, floodplains, uplands, valley side slopes, toeslopes, and footslopes. They formed in alluviium or eolian sand from mixed sources. Slopes range from 0 to 45 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 2 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse granular structure; loose, soft, nonsticky and nonplastic; noneffervescent; neutral (pH 6.8); gradual wavy boundary. (2 to 6 inches thick)

C1 - 2 to 15 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; neutral (pH 7.2).

C2 - 15 to 44 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; single grain, loose, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.8).

Type Location - Converse County, Wyoming; refer to waypoint 44 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Rock fragments are less than 15 percent in the particle-size control section. Depth to carbonates is typically greater than 40 inches but may be 30 inches in some pedons. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is never moist in all parts for as long as 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 44 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry, 3 to 6 moist, and chroma of 2 to 4. Texture is sand, fine sand, loamy sand and loamy fine sand. Reaction is neutral or slightly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 dry, 4 to 7 moist, and chroma of 2 to 6. Texture is sand, fine sand, loamy sand or loamy fine sand. Some pedons may have thin strata of sandy loam or fine sandy loam where they are near the parent source. Reaction ranges from neutral to moderately alkaline. Some pedons have AC horizons.
Range in Characteristics (according to field observations, lab analysis): Textures are slightly finer than what is typical for this series.

Taxonomic Class - Mixed, mesic Ustic Torripsamments

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 44 inches.

Geographic Setting (According to Official Series Description) - Orpha soils occur primarily as rolling or hilly dunes. They are on hills, valley side slopes, footslopes, toeslopes, stream terraces, broad floodplains and uplands. They formed in alluvium or eolian deposits generally adjacent to and downwind of sandy parent sources. Slopes are usually 0 to 45 percent. In Nebraska slopes are as high as 60 percent. Elevations are 3,500 to 6,500 feet. Precipitation ranges from 10 to 18 inches with over half the annual precipitation falling in April, May, and June. The mean annual air temperature ranges from 44 to 50 degrees F. The frost-free season is about 105 to 130 days.

CUSHMAN
NONCALCAREOUS VARIANT

Soil Mapping Unit "CuNC"
Lab Sample ID: C08100869-143_144
BKS Sample ID: #183

Typical Pedon: Cushman clay loam-on south facing slope of about 3 percent under native grass vegetation. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 4 inches; light brownish gray (10YR 6/2) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; common very fine, fine, and few medium roots; noneffervescent; neutral (pH 7.2); clear smooth boundary. (2 to 6 inches thick)

AB - 4 to 8 inches; light brownish gray (10YR 6/2) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; common very fine, fine, and few medium roots; noneffervescent; neutral (pH 7.2); clear smooth boundary.

Bt - 8 to 22 inches; brown (10YR 5/3) silt loam to loam, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Cr - 22 inches; soft, thickly stratified gray and brown strongly calcareous shale; reaction of crushed fragments strongly alkaline; these shales extend to depths greater than 10 feet.

Type Location - Sheridan County, Wyoming; refer to waypoint 47 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to a paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 to 15 percent and are soft shale channers or semirounded sandstone pebbles. The

soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout.

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. This profile has an AB horizon, but no calcic B horizons, which is not typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 22 inches.

Geographic Setting (According to Official Series Description) - Cushman soils are on buttes, fan remnants fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash alluvium and residuum. Surface

erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3,500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

SHINGLE
SANDY LOAM TO SANDY CLAY LOAM

Soil Mapping Unit "Sh"
Lab Sample ID: C08100869-145_146
BKS Sample ID: #184

Typical Pedon: Shingle sandy loam to sandy clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 5 inches; light brownish gray (10YR 6/2) sandy loam to sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, moderately sticky and moderately plastic; noneffervescent; neutral (pH 7.1); clear smooth boundary. (1 to 6 inches thick)

AC - 5 to 8 inches; light yellowish brown (2.5Y 6/3) sandy loam to sandy clay loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; noneffervescent; neutral (pH 7.1); gradual smooth boundary. (0 to 5 inches thick)

Ck - 8 to 17 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, variable, moderately sticky and moderately plastic; strongly effervescent, lime disseminated; neutral (pH 7.2); clear wavy boundary. (4 to 15 inches thick)

Cr - 17 inches; soft, strongly calcareous shale interbedded with lenses of soft sandstone.

Type Location - Goshen County, Wyoming; refer to waypoint 122 on map included in this report.

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): A calcic horizon was identified at the bottom of this profile, which is not typical for this series. The A and AC horizons have a sandier texture than what is typical of this series.

Taxonomic Class - Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 17 inches.

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

CLARKELEN
SANDY LOAM

Soil Mapping Unit "Cl"
Lab Sample ID: C08100869-147_150
BKS Sample ID: #185

Typical Pedon: Clarkelen sandy loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Clarkelen series consists of very deep, well, moderately well or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. Clarkelen soils are on flood plains and terraces. Slopes range from 0 to 6 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 2 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; neutral (pH 7.2); gradual smooth boundary. (1 to 6 inches thick)

AC - 2 to 19 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; neutral (pH 7.0); gradual smooth boundary.

Ck1 - 19 to 31 inches; light brownish gray (10YR 6/2) weakly stratified sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; soft, very friable, nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; calcium carbonate disseminated throughout; strongly effervescent; slightly alkaline (pH 7.5); abrupt wavy boundary.

Ck2 - 31 to 48 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) stratified sandy loam to sandy clay loam, grayish brown (10YR 5/2) moist; massive; thin stratifications; slight hard, friable, nonsticky and nonplastic; few fine and very fine roots; calcium carbonate disseminated throughout; strongly effervescent; slightly alkaline (pH 7.6); abrupt wavy boundary.

Type Location - Niobrara County, Wyoming; refer to waypoint 123 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) – This soil typically lacks horizons of continuous carbonate accumulation. Depth to carbonates ranges from 0 to 8 inches. Rock fragments are typically less than 5 percent but may range

to 15 percent. Organic matter content decreases irregularly with depth; and thin, highly variable textural strata usually occur between 6 and 24 inches. The particle-size control section contains from 5 to 18 percent clay and is sandy loam, fine sandy loam or loam when averaged. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 4. Texture typically is sandy loam or fine sandy loam but may range from loamy sand to clay loam depending upon the most recent deposition. Reaction ranges from neutral to moderately alkaline. It has an EC of 0 to 4 mmhos/cm. Nitrogen and phosphorus levels are not abnormally enriched. Some pedons have an AC horizon up to 8 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture centers on sandy loam, fine sandy loam or loam, but strata of very fine sandy loam, loam, silt loam, loamy fine sand, loamy sand, fine sand or sand of varying thickness occur. Skeletal material may occur below 40 inches in some pedons. Reaction ranges from slightly alkaline to strongly alkaline. EC is typically 4 mmhos/cm or less but may range up to 8 when irrigated or where it receives saline discharge from surrounding shale beds.

Range in Characteristics (according to field observations, lab analysis): The C horizons of this profile were identified as calcic horizons, which is not typical of this series. This profile contains a slightly higher clay % than what is typical.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal at 31-48 inches. Estimated stripping depth is 31 inches.

Geographic Setting (According to Official Series Description) – Clarkelen soils are on flood plains and terraces adjacent to floodplains. Slopes are 0 to 6 percent. The soils formed in stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock. Elevation is 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from

44 to 49 degrees F. The frost-free season is about 105 to 130 days.

ZIGWEID
NONCALCAREOUS VARIANT

Soil Mapping Unit "ZiNC"
Lab Sample ID: C08100869-151_155
BKS Sample ID: #186

Typical Pedon: Zigweid clay loam-on a 3 percent southwest facing slope; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Zigweid series consists of very deep, well drained soils formed in alluvium from mixed sedimentary sources on fan aprons, alluvial fans, fan piedmonts, fan remnants, terraces, ridges and hills. Slopes range from 0 to 20 percent. Permeability is moderate. The mean annual precipitation is about 13 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 4 inches; light brownish gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; slight hard, friable, nonsticky and nonplastic; many very fine and fine roots throughout; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (4 to 8 inches thick)

AB - 4 to 8 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; slight hard, friable, nonsticky and nonplastic; many very fine and fine roots throughout; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bw1 - 8 to 18 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots throughout and few medium throughout; noneffervescent; neutral (pH 7.0); gradual wavy boundary. (6 to 14 inches thick)

Bw2 - 18 to 31 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots throughout and few medium throughout; noneffervescent; neutral (pH 6.9); gradual wavy boundary. (6 to 14 inches thick)

C1 - 31 to 43 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots throughout; noneffervescent; slightly alkaline (pH 7.5); gradual wavy boundary.

C2 - 43 to 60 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots throughout; noneffervescent; neutral (pH 7.0).

Type Location - Campbell County, Wyoming; refer to waypoint 124 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to carbonates ranges from 0 to 8 inches. Depth to the Bk horizon and the base of the cambic horizon ranges from 10 to 22 inches. The particle-size control section and soil profile are clay loam or loam. Clay ranges from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with more than 15 percent but less than 35 percent fine sand or coarser. Rock fragments range from 0 to 15 but are typically less than 5 percent and are mostly soft shale chips. The moisture control section is usually dry in all parts for 90 cumulative days following the summer solstice and for 60 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F. The soil temperature at a depth of 20 inches is 41 degrees F or warmer for 175 to 192 days.

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

The Bw horizon has hue of 5Y, 2.5Y or 10YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is loam or clay loam. Reaction is slightly alkaline or moderately alkaline.

The Bk horizon has hue of 5Y, 2.5Y or 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. It is loam or clay loam. It has 5 to 14 percent calcium carbonate equivalent and may have a few scattered crystals of calcium sulfate. Reaction is moderately alkaline or strongly alkaline.

Some pedons have a C horizon with similar properties as the Bk horizon. Some pedons may have sandy clay loam textures below 40 inches. It typically has 3 to 5 percent less calcium carbonate than the overlying Bk horizon.

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. This profile has an AB horizon, but no calcic B horizons, which is not typical of this series. This profile has a sandy clay loam texture above 40 inches, which is also not typical.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplocambids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) - These soils are on fan aprons, alluvial fans, terraces, fan piedmonts, fan remnants, ridges and hills. In many areas they are dissected. Slopes range from 0 to 20 percent. These soils formed in calcareous, moderately fine textured sediments derived from interbedded shale and soft sandstone. Elevations are 3,500 to 6,600 feet. The mean annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F, and ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

RENOHILL
CLAY

Soil Mapping Unit "Re"
Lab Sample ID: C08100869-156_158
BKS Sample ID: #187

Typical Pedon: Renohill silty clay-rangeland. (Colors are for dry soil unless otherwise stated.)

The Renohill series consists of well drained soils that are moderately deep to soft bedrock. These soils formed in alluvium, colluvium, and residuum. Renohill soils are on bedrock controlled plateaus, alluvial fans, hills and ridges. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 45 degrees F.

A - 0 to 3 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; common medium and fine roots; noneffervescent; neutral (pH 7.2); clear smooth boundary. (1 to 6 inches thick)

BA - 3 to 8 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, sticky and plastic; common fine and medium roots; noneffervescent; neutral (pH 7.2); clear smooth boundary. (0 to 5 inches thick)

Bt1 - 8 to 12 inches; light olive brown (2.5Y 5/4) heavy clay, olive brown (2.5Y 4/4) moist; moderate medium prismatic parting to moderate medium angular blocky; very hard, firm, very sticky and very plastic; common fine and medium roots; many prominent clay films on faces of peds and lining root channels and pores; moderately effervescent; slightly alkaline (pH 7.5); clear smooth boundary. (4 to 16 inches thick)

Bt2 - 12 to 17 inches; light yellowish brown (2.5Y 6/4) heavy clay, light olive brown (2.5Y 5/4) moist; weak coarse angular and subangular blocky structure; very hard, firm, sticky and plastic; few faint clay films on faces of peds; slightly effervescent; slightly alkaline (pH 7.5); gradual smooth boundary. (4 to 16 inches thick)

Bn - 17 to 22 inches; light brownish gray (2.5Y 6/2) heavy clay, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; noneffervescent, sodium occurs as common soft masses and threads; about 5 percent soft shale chips; neutral (pH 7.1); clear smooth boundary. (5 to 20 inches thick)

Cr - 22 inches; soft, noncalcareous shale with thin lenses of sandstone

Type Location - Campbell County, Wyoming; refer to waypoint 62 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to bedrock and the paralithic contact ranges from 20 to 40 inches. Depth to the base of the argillic horizon ranges from 12 to 28 inches. Depth to carbonates ranges from 10 to 20 inches. Rock fragments are typically less than 5 percent but may range from 0 to 15 percent. The majority of the rock fragments are soft and break down upon pretreatment. The mean annual soil temperature is about 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

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

The Bt horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry and 4 or 5 moist, and chroma of 2 to 5. Texture is clay or heavy clay loam with 35 to 50 percent clay. EC is less than 2 mmhos. Reaction is neutral to moderately alkaline. This horizon is typically noncalcareous throughout but may be effervescent immediately above the Btk horizon.

The Btk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture is clay, clay loam, silty clay loam or silty clay with 35 to 50 percent clay. Secondary carbonates range from 3 to 12 percent. EC ranges up to 4 mmhos/cm. Reaction is moderately alkaline or strongly alkaline.

The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 6. Texture is clay loam, clay, silty clay loam or silty clay with 28 to 42 percent clay. Secondary carbonates range from 5 to 15 percent. EC ranges up to 4 mmhos/cm. Reaction is moderately alkaline or strongly alkaline.

The Cr horizon consists of soft, effervescent shale interbedded with thin lenses of sandstone or siltstone. In some pedons the bedrock is noneffervescent.

Range in Characteristics (according to field observations, lab analysis): There is a natric B horizon instead of a calcic B horizon for this profile. The A horizon in this profile has a finer texture than what is typical for this series.

Taxonomic Class - Fine, smectitic, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-22 inches. Estimated stripping depth is 17 inches.

Geographic Setting (According to Official Series Description) - Renohill soils are on bedrock controlled plateaus, alluvial fans, hills and ridges. They formed in alluvium, colluvium and residuum derived from calcareous shale. Slopes are 0 to 30 percent.

Elevations are 3,500 to 6,000 feet. The mean annual precipitation ranges from 10 to 14 inches most of which falls as snow and rain in April, May, and early June. The mean annual air temperature ranges from 43 to 47 degrees F. The frost-free period is 105 to 130 days.

KEELINE
SANDY LOAM TO SANDY CLAY LOAM

Soil Mapping Unit "Ke"
Lab Sample ID: C08100869-159_162
BKS Sample ID: #188

Typical Pedon: Keeline sandy loam to sandy clay loam-on east facing shoulder slope of 4 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

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

AC - 3 to 9 inches; pale brown (10YR 6/3) sandy loam to sandy clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary. (0 to 7 inches thick)

C1 - 9 to 21 inches; very pale brown (10YR 7/3) fine sandy loam to fine sandy clay loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; moderately effervescent; moderately alkaline (pH 8.0); gradual smooth boundary. (8 to 50 inches thick)

C2 - 21 to 30 inches; very pale brown (10YR 7/3) very fine sandy clay loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent; calcium carbonate disseminated; moderately alkaline (pH 8.2); gradual smooth boundary. (0 to 25 inches thick)

C3 - 30 to 48 inches; very pale brown (10YR 7/3) very fine sandy clay loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; strongly effervescent, calcium carbonate disseminated; neutral (pH 7.0).

Type Location - Converse County, Wyoming; refer to waypoint 83 on map included in this report.

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

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

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

Some pedons have an AC horizon.

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

Range in Characteristics (according to field observations, lab analysis): This texture has a slightly higher clay % than what is typical for this series.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – An unsuitable SAR was found from 21-30 inches. Estimated stripping depth is 21 inches.

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

season is about 105 to 130 days.

BOWBAC
SANDY CLAY

Soil Mapping Unit "Bo"
Lab Sample ID: C08100869-163_165
BKS Sample ID: #189

Typical Pedon: Bowbac sandy clay -on a northeast facing slope of 1 percent under native vegetation. (Colors are for dry soil unless otherwise stated.)

The Bowbac series consists of moderately deep, well drained soils formed in alluvium, eolian deposits or residuum derived primarily from argillaceous sandstone. They occupy alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent and both simple and complex. The mean annual precipitation is about 13 inches, and the mean annual temperature is about 46 degrees F.

A - 0 to 3 inches; brown (10YR 5/3) sandy clay, dark brown (10YR 3/3) moist; weak fine and very fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; noneffervescent; slightly alkaline (pH 7.8); abrupt wavy boundary. (2 to 7 inches thick)

Bt - 3 to 8 inches; yellowish brown (10YR 5/4) heavy sandy clay, brown (10YR 4/3) moist; moderate coarse and medium prismatic structure parting to moderate medium and coarse angular blocky; hard, friable, slightly sticky and moderately plastic; common fine and very fine, few medium and coarse roots; many distinct clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.8); clear wavy boundary.

Btk - 8 to 18 inches; yellowish brown (10YR 5/4) very fine sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium fine and very fine roots; common distinct clay films on faces of peds; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bk - 18 to 24 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; massive; soft, friable, slightly plastic; few medium, fine and very fine roots; violently effervescent, calcium carbonate as few fine and medium soft masses; neutral (pH 7.3); abrupt smooth boundary. (6 to 18 inches thick)

Cr - 24 inches; slightly hard, violently effervescent, argillaceous sandstone.

Type Location - Campbell County, Wyoming; refer to waypoint 80 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded gravel. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

The A horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. Textures are loamy fine sand, sandy loam, sandy clay loam, fine sandy loam, very fine sandy loam, or loam. Reaction is typically neutral or slightly alkaline but ranges to moderately alkaline in some pedons.

The Bt horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. In pedons where mollic colors are present in this horizon, the layer is too thin to meet the requirements for a mollic epipedon. Texture is sandy clay loam with more than 35 percent fine sand or coarser. Clay ranges from 20 to 35 percent. Reaction is typically slightly alkaline but may range from neutral to moderately alkaline.

Some pedons have a Btk horizon.

The Bk horizon has hue of 2.5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 6. Texture is typically sandy loam or sandy clay loam but may be fine sandy loam or very fine sandy loam. Carbonates range from 6 to 14 percent. This horizon does not meet the requirements of a diagnostic calcic. Discontinuous horizons with greater than 15 percent carbonates occur in some pedons. Reaction is moderately or strongly alkaline with less than 15 percent ESP.

The Cr is a paralithic contact to calcareous, argillaceous sandstone. This material is weakly consolidated and does restrict the movement of water and, therefore, roots. Interbedded shales may be present in some areas and may form the contact.

Range in Characteristics (according to field observations, lab analysis): The texture of the Bk horizon is finer than typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – SAR is unsuitable from 0-8 inches and 18-24 inches. Estimated stripping depth is 0 inches.

Geographic Setting (According to Official Series Description) - Bowbac soils are on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

DECOLNEY
SANDY LOAM

Soil Mapping Unit "De"
Lab Sample ID: C08100869-166_169
BKS Sample ID: #190

Typical Pedon: Decolney sandy loam-on a north facing slope of 3 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Decolney series consists of very deep, well drained soils that formed in alluvium or eolian deposits derived from sedimentary beds. Decolney soils are on stabilized dune topography on uplands. Slopes range from 0 to 20 percent. The mean annual precipitation is about 13 inches, and the mean annual air temperature is about 47 degrees F.

A - 0 to 3 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; many fine and very fine roots; common fine pores; noneffervescent; neutral (pH 7.3); abrupt smooth boundary. (2 to 5 inches thick)

Bt - 3 to 14 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine pores; many faint dark brown (10YR 3/3) clay films on faces of peds and lining pores; noneffervescent; moderately alkaline (pH 7.9); clear wavy boundary.

Ck - 14 to 38 inches; brown (10YR 5/3) very fine sandy clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; calcium carbonate disseminated; violently effervescent; slightly alkaline (pH 7.8); abrupt wavy boundary.

C - 38 to 48 inches; pale brown (10YR 6/3) coarse sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; slightly effervescent; slightly alkaline (pH 7.4).

Type Location - Campbell County, Wyoming; refer to waypoint 104 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to the base of the argillic horizon is 10 to 30 inches. Depth to carbonates is greater than 40 inches. The mean annual soil temperature is 47 to 52 degrees F. The soil is usually dry at a depth of 20 inches when the temperature is 41 degrees F. The moisture control section is dry for at least 60 consecutive days and 90 cumulative days between July 15 and

October 25. The soil temperature is 41 degrees F or greater for 175 to 192 days. Rock fragments range from 0 to 10 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry, 3 or 4 moist, and chroma of 2 or 3. It is fine sandy loam, sandy loam, sandy clay loam or loam. It is neutral or slightly alkaline.
The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 3 or 4. It is sandy clay loam. It has 20 to 35 percent clay and more than 35 percent fine or coarser sand in the particle-size control section. It is neutral to moderately alkaline.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is fine sandy loam, sandy loam or sandy clay loam with 10 to 24 percent clay and more than 35 percent fine or coarser sand. It is slightly alkaline or moderately alkaline.

Range in Characteristics (according to field observations, lab analysis): A calcic C horizon was identified for this profile, which is not typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – SAR is marginal from 0-3 inches. Estimated stripping depth is 14 inches.

Geographic Setting (According to Official Series Description) - Decolney soils are on stabilized dune topography including alluvial fans, fan remnants, pediments, terraces, plateaus, ridges and hills. They formed in eolian or alluvium deposits derived from mixed sedimentary bedrock. Slopes are 0 to 20 percent. Elevations range from 3,500 to 5,200 feet. The mean annual precipitation is 10 to 14 inches, about half of which falls as rain or snow from late March through June. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free period is estimated to range from 105 to 130 days.

TULLOCK
NONCALCAREOUS VARIANT

Soil Mapping Unit "TlNC"
Lab Sample ID: C08100869-170_173
BKS Sample ID: #191

Typical Pedon: Tullock sandy loam to sandy clay loam-in rangeland. (Colors are for dry soil unless otherwise stated.)

The Tullock series consists of moderately deep, excessively drained soils formed in residuum, alluvium or eolian deposits derived from sandstone. They are on dunes, hills and ridges. Slopes are 0 to 45 percent. The mean annual precipitation is about 12 inches. The mean annual air temperature is about 46 degrees F.

A - 0 to 3 inches; brown (10YR 5/3) sandy loam to sandy clay loam, brown (10YR 4/3) moist; weak medium and fine granular structure; loose; noneffervescent; slightly alkaline (pH 7.5); clear wavy boundary. (2 to 6 inches thick)

AC - 3 to 11 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium and fine granular structure; loose; noneffervescent; slightly alkaline (pH 7.6); clear wavy boundary.

C1 - 11 to 18 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; massive; loose; noneffervescent; moderately alkaline (pH 8.1); clear wavy boundary. (0 to 18 inches thick)

C2 - 18 to 34 inches; pale brown (10YR 6/3) gravelly sandy loam to sandy clay loam, brown (10YR 5/3) moist; massive; loose; noneffervescent; moderately alkaline (pH 8.1); clear wavy boundary.

Cr - 34 inches; soft moderately calcareous sandstone.

Type Location - Converse County, Wyoming; refer to waypoint 84 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - These soils typically effervesce throughout but some in some pedons the A horizon is leached. Depth to paralithic contact is 20 to 40 inches. The soil has 0 to 15 percent rock fragments. These soils are usually dry in the moisture control section for 60 consecutive days and 90 cumulative days between July 15 and October 25. The soil temperature at a depth of 20 inches is 41 degrees F or warmer for 175 to 192 days. The mean annual soil temperature is 47 to 53 degrees F.

The A horizon has hue of 2.5Y or 10YR value of 5 or 6 and 3 to 5 moist, and chroma of 2 to 5. It is loamy sand, sand, loamy fine sand, fine sandy loam or fine sand. It is neutral to moderately alkaline.

Some pedons have an AC horizon. When present, it has hue or 2.5Y or 10YR, value of 5 or 6 and 4 or 5 moist, and chroma of 3 or 4. It is loamy sand, loamy fine sand, fine sand or sand.

The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 6. It is loamy sand, loamy fine sand, fine sand or sand. It is slightly alkaline or moderately alkaline.

The Cr horizon is soft calcareous sandstone which may be interbeded with conglomerate or shale in some areas.

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. Textures are slightly finer in the A and C2 horizons than what is typical for this series.

Taxonomic Class - Mixed, mesic Ustic Torripsamments

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage is marginal from 3-11 inches. Estimated stripping depth is 18 inches.

Geographic Setting (According to Official Series Description) - Tullock soils are on dunes and footslopes and toeslopes of hills and ridges. They formed in eolian deposits and residuum derived from sandstone. Slopes are 0 to 45 percent. Elevation is 3500 to 6,000 feet. Mean annual soil temperature is 47 to 53 degrees F. Mean annual precipitation is 10 to 14 inches. The frost-free period is 105 to 130 days.

SHINGLE
CLAY LOAM

Soil Mapping Unit "Sh"
Lab Sample ID: C08100869-174_175
BKS Sample ID: #192

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

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

A - 0 to 1 inch; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, moderately sticky and moderately plastic; slightly effervescent; neutral (pH 7.1); clear smooth boundary. (1 to 6 inches thick)

C - 1 to 8 inches; light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) moist; massive; hard, variable, moderately sticky and moderately plastic; slightly effervescent; neutral (pH 7.3); clear wavy boundary. (4 to 15 inches thick)

Cr - 8 inches; soft, strongly calcareous shale interbedded with lenses of soft sandstone.

Type Location - Goshen County, Wyoming; refer to waypoint 87 on map included in this report.

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

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

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

The C horizon has hue of 5Y through 7.5YR, value of 4 through 7 dry, 3 through 6 moist, and chroma of 1 through 6. It is loam, silt loam, clay loam or silty clay loam. Rock fragments or shale channers range from 0 to 35 percent. Reaction is slightly alkaline through strongly alkaline.
Range in Characteristics (according to field observations, lab analysis): The C horizon for this profile has a finer texture than what is typical for this series.

Taxonomic Class - Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 1-8 inches. Estimated stripping depth is 8 inches.

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

ULM
CLAY LOAM

Soil Mapping Unit "Ul"
Lab Sample ID: C08100869-176_180
BKS Sample ID: #193

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

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

A - 0 to 3 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; strong fine granular structure; slightly hard, friable, sticky and plastic; many fine and few medium roots; noneffervescent; neutral (pH 6.6); clear smooth boundary. (2 to 5 inches thick)

Bt - 3 to 10 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.5); clear wavy boundary. (6 to 23 inches thick)

Bk1 - 10 to 18 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; strongly effervescent; calcium carbonate as common distinct masses, seams and streaks; moderately alkaline (pH 7.9); clear wavy boundary.

Bk2 - 18 to 36 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; calcium carbonate as common distinct masses, seams and streaks; strongly effervescent; moderately alkaline (pH 8.0).

Cn - 36 to 60 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; sodium as common distinct masses, seams and streaks; slightly effervescent; slightly alkaline (pH 7.8).

Type Location - Campbell County, Wyoming; refer to waypoint 88 on map included in this report.

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

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

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

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

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

Some pedons have a C horizon.

Range in Characteristics (according to field observations, lab analysis): A natric C horizon was identified at the bottom of this profile, which is not typical of this series.

Taxonomic Class - Fine, smectitic, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 3-10 inches and 36-60 inches. Estimated stripping depth is 36 inches.

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

PETRIE
CLAY TO CLAY LOAM

Soil Mapping Unit "Pe"
Lab Sample ID: C08100869-181_184
BKS Sample ID: #194

Typical Pedon: Petrie clay to clay loam-rangeland. (Colors are for dry soil unless otherwise stated.)

The Petrie series consists of deep, well drained soils that formed in alluvium derived from sodic sedimentary rock. These soils are on fan aprons, fan pediments, and alluvial terraces. Slopes are 0 to 10 percent. The mean annual precipitation is about 13 inches, and the mean annual temperature is about 45 degrees F.

A - 0 to 3 inches; light yellowish brown (2.5Y 6/4) clay to clay loam, light olive brown (2.5Y 5/4) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; noneffervescent; slightly alkaline (pH 7.5); clear smooth boundary. (1 to 6 inches thick)

AC - 3 to 8 inches; light yellowish brown (2.5Y 6/4) clay to clay loam, light olive brown (2.5Y 5/4) moist; weak medium subangular blocky structure parting to moderate coarse granular; slightly hard, friable, slightly sticky and slightly plastic; common fine and few medium roots; noneffervescent; slightly alkaline (pH 7.5); clear wavy boundary. (2 to 7 inches thick)

C1 - 8 to 17 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, firm, sticky and plastic; few fine roots; strongly effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

C2 - 17 to 32 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, very firm, sticky and plastic; few fine roots; strongly effervescent; moderately alkaline (pH 8.4).

C3 - 32 to 44 inches; light yellowish brown (2.5Y 6/4) clay to clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, very firm, sticky and plastic; few fine roots; slightly effervescent; moderately alkaline (pH 8.1).

Cr - 44 inches; noneffervescent mixed black and gray shale.

Type Location - Natrona County, Wyoming; refer to waypoint 16 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - These soils are typically calcareous throughout but may be leached a few inches in some pedons. The mean annual soil temperature is 47 to 53 degrees F. The particle size control section is a clay, silty clay, clay loam, or silty clay loam with 35 to 60 percent clay. Exchangeable sodium ranges from 15 to 40 percent throughout the control section. Rock fragments are typically less than 5 percent but range from 0 to 15 percent rounded pebbles. Calcium carbonate equivalent ranges from 1 to about 8 percent. The majority of the carbonates and gypsum are autogenetic with only minor secondary accumulations with depth.

The A horizon has hue of 2.5Y through 7.5YR, value of 5 through 7 dry, 3 through 5 moist, and chroma of 2 through 4. Cracks one cm wide extend to the surface of most pedons. EC ranges from 2 to 4 mmhos. Reaction is moderately through very strongly alkaline.

The AC horizon has hue of 2.5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is typically clay loam or clay but may be silty clay or silty clay loam. Cracks one cm wide extend through this horizon. EC ranges from 2 to 4 mmhos. Reaction is strongly or very strongly alkaline. Some pedons have a Bw horizon in place of the AC horizon. This is allowed since the distinction is difficult at best between the two.

The C horizon has hue of 2.5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is typically clay loam or clay but may be silty clay or silty clay loam. Cracks are common to a depth of 30 inches or more in this horizon. Autogenetic carbonates and gypsum range from few to common soft masses and nests of crystals. EC ranges from 4 to 8 mmhos in nonirrigated areas. Some areas, where irrigated, have seasonal water tables and EC may range up to 16 mmhos. Reaction is strongly or very strongly alkaline.

Range in Characteristics (according to field observations, lab analysis): This profile is less alkaline than what is typical of this series.

Taxonomic Class - Fine, smectitic, calcareous, mesic Ustertic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 0-8 inches and 32-44 inches. Estimated stripping depth is 36 inches.

Geographic Setting (According to Official Series Description) - Petrie soils are on fan aprons, fan pediments, alluvial terraces, and to a limited extent low energy alluvial fans. These soils formed in alluvium derived from sodic shale and siltstone. Slopes are 0 to 10 percent. Elevation is 3,700 to 6,500 feet. The mean annual precipitation is about 13 inches and ranges from 10 to 16 inches of which about half falls as snow or rain in April, May, and early June. The mean annual air temperature ranges from 43 to 49 degrees F. The frost-free season is estimated to range from 105 to 130 days depending upon

elevation, aspect, and local air drainage.

KEELINE
NONCALCAREOUS VARIANT

Soil Mapping Unit "KeNC"
Lab Sample ID: C08100869-185_188
BKS Sample ID: #195

Typical Pedon: Keeline very fine sandy loam-on east facing shoulder slope of 4 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 3 inches; yellowish brown (10YR 5/4) very fine sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky and granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; neutral (pH 7.3); abrupt smooth boundary. (2 to 8 inches thick)

AC - 3 to 9 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; noneffervescent; neutral (pH 7.3); clear smooth boundary. (0 to 7 inches thick)

C1 - 9 to 18 inches; very pale brown (10YR 7/3) very fine sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.4); gradual smooth boundary. (8 to 50 inches thick)

C2 - 18 to 37 inches; very pale brown (10YR 7/3) very fine sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; slightly alkaline (pH 7.8); gradual smooth boundary. (0 to 25 inches thick)

C3 - 37 to 48 inches; very pale brown (10YR 7/3) very fine sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; noneffervescent; moderately alkaline (pH 8.0).

Type Location - Converse County, Wyoming; refer to waypoint 23 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6

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

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

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

Some pedons have an AC horizon.

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

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout.

Taxonomic Class - Coarse-loamy, mixed, superactive, noncalcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage is marginal from 0-48 inches. Estimated stripping depth is 48 inches.

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

DECOLNEY
SANDY LOAM

Soil Mapping Unit "De"
Lab Sample ID: C08100869-189_193
BKS Sample ID: #197

Typical Pedon: Decolney sandy loam-on a north facing slope of 3 percent; utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Decolney series consists of very deep, well drained soils that formed in alluvium or eolian deposits derived from sedimentary beds. Decolney soils are on stabilized dune topography on uplands. Slopes range from 0 to 20 percent. The mean annual precipitation is about 13 inches, and the mean annual air temperature is about 47 degrees F.

A - 0 to 4 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; many fine and very fine roots; common fine pores; noneffervescent; neutral (pH 7.1); abrupt smooth boundary. (2 to 5 inches thick)

Bt - 4 to 10 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine pores; many faint dark brown (10YR 3/3) clay films on faces of peds and lining pores; noneffervescent; neutral (pH 7.3); clear wavy boundary.

C1 - 10 to 19 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; noneffervescent; slightly alkaline (pH 7.6); abrupt wavy boundary. (5 to 21 inches thick)

C2 - 19 to 36 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; noneffervescent; moderately alkaline (pH 8.2).

C3 - 36 to 48 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; noneffervescent; moderately alkaline (pH 8.3).

Type Location - Campbell County, Wyoming; refer to waypoint 25 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to the base of the argillic horizon is 10 to 30 inches. Depth to carbonates is greater than 40 inches. The mean annual soil temperature is 47 to 52 degrees F. The soil is usually dry at

a depth of 20 inches when the temperature is 41 degrees F. The moisture control section is dry for at least 60 consecutive days and 90 cumulative days between July 15 and October 25. The soil temperature is 41 degrees F or greater for 175 to 192 days. Rock fragments range from 0 to 10 percent.

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

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 3 or 4. It is sandy clay loam. It has 20 to 35 percent clay and more than 35 percent fine or coarser sand in the particle-size control section. It is neutral to moderately alkaline.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is fine sandy loam, sandy loam or sandy clay loam with 10 to 24 percent clay and more than 35 percent fine or coarser sand. It is slightly alkaline or moderately alkaline.

Range in Characteristics (according to field observations, lab analysis): The textures from 19-48 inches are coarser than typical for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (sand) was found from 36-48 inches. Saturation percentage was marginal from 0-48 inches. Estimated stripping depth is 36 inches.

Geographic Setting (According to Official Series Description) - Decolney soils are on stabilized dune topography including alluvial fans, fan remnants, pediments, terraces, plateaus, ridges and hills. They formed in eolian or alluvium deposits derived from mixed sedimentary bedrock. Slopes are 0 to 20 percent. Elevations range from 3,500 to 5,200 feet. The mean annual precipitation is 10 to 14 inches, about half of which falls as rain or snow from late March through June. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free period is estimated to range from 105 to 130 days.

THEEDLE
SANDY LOAM

Soil Mapping Unit "Th"
Lab Sample ID: C08100869-194_195
BKS Sample ID: #198

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

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

A - 0 to 2 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; noneffervescent; neutral (pH 6.6); clear smooth boundary. (0 to 5 inches thick)

AB - 2 to 6 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; noneffervescent; neutral (pH 6.6); clear smooth boundary.

Bw - 6 to 18 inches; light brownish gray (2.5Y 6/2) sandy loam to sandy clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary. (4 to 12 inches thick)

C - 18 to 22 inches; light gray (2.5Y 7/2) sandy loam to sandy clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; slightly effervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Cr - 22 inches; light gray, soft, strongly calcareous sandstone.

Type Location - Weston County, Wyoming; refer to waypoint 26 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to soft, gray, calcareous sandstone or sandy shale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be

leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

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

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

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

Range in Characteristics (according to field observations, lab analysis): The AB, Bw, and C horizons are slightly more coarse than what is typical of this series.

Taxonomic Class - Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal from 0-22 inches. Estimated stripping depth is 22 inches.

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

FORKWOOD
NONCALCAREOUS VARIANT

Soil Mapping Unit "FoNC"
Lab Sample ID: C08100869-196_200
BKS Sample ID: #199

Typical Pedon: Forkwood sandy clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

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

A - 0 to 3 inches; brown (10YR 5/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; moderately acid (pH 6.0); abrupt smooth boundary. (1 to 6 inches thick)

AB - 3 to 14 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots throughout; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.

Bt1 - 14 to 26 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common fine and medium roots throughout; common distinct clay films on faces of peds; noneffervescent; neutral (pH 7.1); clear smooth boundary. (6 to 20 inches thick)

Bt2 - 26 to 43 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; strong medium angular blocky structure; hard, firm, moderately sticky and moderately plastic; few fine and medium roots throughout; few faint clay films on faces of peds; noneffervescent; neutral (pH 7.2); clear smooth boundary.

C - 43 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots throughout; noneffervescent; slightly alkaline (pH 7.4). (0 to 40 inches thick)

Type Location - Niobrara County, Wyoming; refer to waypoint 27 on map included in this report.

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

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): This profile is noncalcareous throughout. An AB horizon was found for this profile, which is not typical for this series. The texture from 14-60 inches is sandy clay loam, which is not a typical texture for this series.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal from 14-26 inches and 43-60 inches. Estimated stripping depth is 60 inches.

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

CAMBRIA
SANDY LOAM TO SANDY CLAY LOAM

Soil Mapping Unit "Ca"
Lab Sample ID: C08100869-201_205
BKS Sample ID: #201

Typical Pedon: Cambria sandy loam to sandy clay loam on rangeland. (Colors are for dry soil unless otherwise stated.)

The Cambria series consists of very deep, well drained, moderately permeable soils that formed in alluvium and slope alluvium on fan remnants, alluvial fans, fan piedmonts, terraces, ridges and hills. Slopes range from 0 to 15 percent and are usually simple but may be complex where the area has been dissected by ephemeral streams. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 45 degrees F.

A - 0 to 2 inches; brown (10YR 5/3) sandy loam to sandy clay loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; noneffervescent; neutral (pH 7.1); clear smooth boundary. (2 to 5 inches thick)

Bt - 2 to 10 inches; brown (10YR 5/3) sandy clay, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; common distinct dark brown (10YR 3/3) clay films on faces of peds; noneffervescent; slightly alkaline (pH 7.5); clear wavy boundary. (5 to 8 inches thick)

Btk - 10 to 31 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline (pH 8.2); gradual wavy boundary.

C1 - 31 to 42 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; moderately effervescent; moderately alkaline (pH 8.3).

C2 - 42 to 48 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline (pH 8.1).

Type Location - Campbell County, Wyoming; refer to waypoint 170 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) –
Soil moisture: The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 48 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.
Depth to the base of the argillic horizon: 10 inches or less
Depth to secondary calcium carbonate: 3 to 10 inches but ranges to 15 inches in some pedons

Particle-size control section: It is loam, clay loam, silty clay loam or sandy clay loam. The part below the argillic horizon averages 18 to 35 percent clay, 10 to 50 percent silt, and 20 to 70 percent sand with more than 15 but less than 52 percent coarser than very fine sand.

A horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4 dry or moist
Texture: fine sandy loam, sandy loam, loam, very fine sandy loam or silt loam
Reaction: typically neutral or slightly alkaline but may be moderately alkaline in some pedons

Some pedons have an AB horizon up to 4 inches thick.

Bt horizon:
Hue: 7.5YR, 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4 dry or moist
Texture: loam, clay loam, silty clay loam or sandy clay loam
Reaction: neutral to moderately alkaline

A thin Btk horizon may be present above the Bk horizon in some pedons and have properties of both the Bt and Bk.

Bk horizon:
Hue: 10YR or 2.5Y
Value: 5 to 8 dry, 4 to 6 moist
Chroma: 2 to 4 dry or moist
Texture: typically loam or clay loam but some subhorizons have sandy loam, fine sandy loam, very fine sandy loam, silt loam, silty clay loam or sandy clay loam strata
Calcium carbonate equivalent: averages less than 15 percent, but discontinuous strata may exceed 15 percent in some pedons

Reaction: moderately or strongly alkaline with less than 15 percent ESP

Some pedons have a C horizon

Range in Characteristics (according to field observations, lab analysis): Two C horizons were found in this profile, instead of two calcic B horizons, which is not typical of this series. This profile's Bt horizon is a sandy clay, which is not a typical texture for that horizon.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – No marginal or unsuitable parameters were found for this profile. Estimated stripping depth is 60 inches.

Geographic Setting (According to Official Series Description) –
Parent material: alluvium and slope alluvium from mixed sources
Landform: fan remnants, fan piedmonts, alluvial fans, hills, ridges and terraces
Slopes: 0 to 15 percent
Elevations: 3,500 to 6,500 feet
Average annual precipitation: 10 to 14 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October
Mean annual air temperature: 43 to 51 degrees F
Frost-free season: 105 to 130 days

CLARKELEN
CLAY

Soil Mapping Unit "Cl"
Lab Sample ID: C08100869-206_210
BKS Sample ID: #202

Typical Pedon: Clarkelen clay-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Clarkelen series consists of very deep, well, moderately well or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. Clarkelen soils are on flood plains and terraces. Slopes range from 0 to 6 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 4 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; neutral (pH 7.1); gradual smooth boundary. (1 to 6 inches thick)

C1 - 4 to 17 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; slightly alkaline (pH 7.6); abrupt wavy boundary.

C2 - 17 to 27 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) stratified loam, grayish brown (10YR 5/2) moist; massive; thin stratifications; slight hard, friable, nonsticky and nonplastic; few fine and very fine roots; noneffervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

C3 - 27 to 36 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; moderately effervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

C4 - 36 to 43 inches; grayish brown (10YR 5/2) sandy loam to sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; slightly hard, friable, nonsticky and nonplastic; few fine roots; noneffervescent; slightly alkaline (pH 7.6).

C5 - 43 to 48 inches; grayish brown (10YR 5/2) coarse sandy loam to sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; slightly hard, friable, nonsticky and nonplastic; few fine roots; slightly effervescent; slightly alkaline (pH 7.6).

Type Location - Niobrara County, Wyoming; refer to waypoint 102 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) – This soil typically lacks horizons of continuous carbonate accumulation. Depth to carbonates ranges from 0 to 8 inches. Rock fragments are typically less than 5 percent but may range to 15 percent. Organic matter content decreases irregularly with depth; and thin, highly variable textural strata usually occur between 6 and 24 inches. The particle-size control section contains from 5 to 18 percent clay and is sandy loam, fine sandy loam or loam when averaged. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 4. Texture typically is sandy loam or fine sandy loam but may range from loamy sand to clay loam depending upon the most recent deposition. Reaction ranges from neutral to moderately alkaline. It has an EC of 0 to 4 mmhos/cm. Nitrogen and phosphorus levels are not abnormally enriched. Some pedons have an AC horizon up to 8 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture centers on sandy loam, fine sandy loam or loam, but strata of very fine sandy loam, loam, silt loam, loamy fine sand, loamy sand, fine sand or sand of varying thickness occur. Skeletal material may occur below 40 inches in some pedons. Reaction ranges from slightly alkaline to strongly alkaline. EC is typically 4 mmhos/cm or less but may range up to 8 when irrigated or where it receives saline discharge from surrounding shale beds.

Range in Characteristics (according to field observations, lab analysis): The top 17 and bottom 12 inches of this profile have a finer texture than what is typical of this series.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay and silty clay) was found from 0-17 inches. Estimated stripping depth is 48 inches.

Geographic Setting (According to Official Series Description) – Clarkelen soils are on flood plains and terraces adjacent to floodplains. Slopes are 0 to 6 percent. The soils

formed in stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock. Elevation is 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

CUSHMAN
CLAY LOAM

Soil Mapping Unit "Cu"
Lab Sample ID: C08100869-211_214
BKS Sample ID: #203

Typical Pedon: Cushman clay loam-on south facing slope of about 3 percent under native grass vegetation. (Colors are for dry soil unless otherwise stated.)

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

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

Bt - 2 to 8 inches; brown (10YR 5/3) sandy clay, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Btk - 8 to 21 inches; pale brown (10YR 6/3) clay, yellowish brown (10YR 5/4) moist; moderate coarse prismatic structure parting to moderate fine and very fine subangular blocky; hard, firm, moderately sticky and moderately plastic; few fine roots; few faint clay films on faces of peds; strongly effervescent; calcium carbonate on faces of peds and in pores as common distinct irregularly shaped filaments and masses; moderately alkaline (pH 8.0); clear smooth boundary. (0 to 13 inches thick)

Cn - 21 to 40 inches; very pale brown (10YR 8/2) loam, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; slightly effervescent; sodium as common prominent irregularly shaped, masses and many fine filaments; moderately alkaline (pH 7.9); clear smooth boundary. (7 to 19 inches thick)

Cr - 40 inches; soft, thickly stratified gray and brown slightly calcareous shale; these shales extend to depths greater than 10 feet.

Type Location - Sheridan County, Wyoming; refer to waypoint 103 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) - Depth to a paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 to 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout.

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

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

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

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

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

Range in Characteristics (according to field observations, lab analysis): This profile has a natric C horizon in place of a calcic B horizon at the bottom of the profile, which is not typical of this series. The A and Btk horizons for this horizon are finer in texture than what is typical. This profile's Bt has a higher percentage of sand and clay than what is

typical.

Taxonomic Class - Fine-loamy, mixed, superactive, mesic Ustic Haplargids

Suitability for Topsoil (According to WDEQ Guideline 1) – Marginal texture (clay) was found from 8-21 inches. Selenium was marginal from 21-40 inches. Estimated stripping depth is 8 inches.

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

CLARKELEN
SANDY CLAY LOAM

Soil Mapping Unit "Cl"
Lab Sample ID: C08100869-215_218
BKS Sample ID: #204

Typical Pedon: Clarkelen sandy clay loam-utilized as rangeland. (Colors are for dry soil unless otherwise stated.)

The Clarkelen series consists of very deep, well, moderately well or somewhat excessively drained soils formed in stratified recent stream alluvium from mixed sedimentary sources. Clarkelen soils are on flood plains and terraces. Slopes range from 0 to 6 percent. The average annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

A - 0 to 3 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; slightly alkaline (pH 7.6); gradual smooth boundary. (1 to 6 inches thick)

AC - 3 to 9 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; noneffervescent; slightly alkaline (pH 7.6); gradual smooth boundary.

C1 - 9 to 22 inches; light brownish gray (10YR 6/2) weakly stratified sandy loam to sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; soft, very friable, nonsticky and nonplastic; common fine and very fine, and few medium roots throughout; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C2 - 22 to 25 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) stratified sandy clay loam, grayish brown (10YR 5/2) moist; massive; thin stratifications; slight hard, friable, nonsticky and nonplastic; few fine and very fine roots; moderately effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

Cn - 25 to 29 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; sodium disseminated throughout; slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

C3 - 29 to 48 inches; grayish brown (10YR 5/2) loamy coarse sand, dark grayish brown (10YR 4/2) moist; massive; thin stratifications; slightly hard, friable, nonsticky and nonplastic; few fine roots; noneffervescent; moderately alkaline (pH 8.4).

Type Location - Niobrara County, Wyoming; refer to waypoint 100 on map included in this report.

Range in Soil Characteristics (According to Official Series Description) – This soil typically lacks horizons of continuous carbonate accumulation. Depth to carbonates ranges from 0 to 8 inches. Rock fragments are typically less than 5 percent but may range to 15 percent. Organic matter content decreases irregularly with depth; and thin, highly variable textural strata usually occur between 6 and 24 inches. The particle-size control section contains from 5 to 18 percent clay and is sandy loam, fine sandy loam or loam when averaged. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F, which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F, and the soil temperature at a depth of 20 inches is 41 degrees F or more for 175 to 192 days.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 4. Texture typically is sandy loam or fine sandy loam but may range from loamy sand to clay loam depending upon the most recent deposition. Reaction ranges from neutral to moderately alkaline. It has an EC of 0 to 4 mmhos/cm. Nitrogen and phosphorus levels are not abnormally enriched. Some pedons have an AC horizon up to 8 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Texture centers on sandy loam, fine sandy loam or loam, but strata of very fine sandy loam, loam, silt loam, loamy fine sand, loamy sand, fine sand or sand of varying thickness occur. Skeletal material may occur below 40 inches in some pedons. Reaction ranges from slightly alkaline to strongly alkaline. EC is typically 4 mmhos/cm or less but may range up to 8 when irrigated or where it receives saline discharge from surrounding shale beds.

Range in Characteristics (according to field observations, lab analysis): This profile has a natric C horizon, which is not typical of the series. Sandy clay loam is not a typical texture for the C horizons.

Taxonomic Class - Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

Suitability for Topsoil (According to WDEQ Guideline 1) – Saturation percentage was marginal from 29-48 inches. Estimated stripping depth is 25 inches.

Geographic Setting (According to Official Series Description) – Clarkelen soils are on flood plains and terraces adjacent to floodplains. Slopes are 0 to 6 percent. The soils formed in stratified but dominantly moderately coarse textured recent stream alluvium originally weathered from sedimentary rock. Elevation is 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over half falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

ADDENDUM 3.3-E
SOIL LABORATORY ANALYSIS

LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

ENERGY LABORATORIES, INC. • 2393 Salt Creek Highway (82601) • P.O. Box 3258 • Casper, WY 82602
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Sample ID	Client Sample ID	Analysis / Units / Depth	EC SatPst mmhos/cm Results	Saturation SatPst % Results	pH SatPst s u Results	Ca SatPst meq/L Results	Mg SatPst meq/L Results	Na SatPst meq/L Results	SAR unitless Results	Sand % Results	Silt % Results	Clay % Results	Texture Results	Coarse Frags % Results	Se-ABDTPA mg/kg-dry Results
C08100869-001	137	0-5	0.52	30.4	6.6	2.94	1.55	0.32	0.21	30	36	34	CL	< 1	0.018
C08100869-002	137	5-12	0.43	38.5	6.8	2.26	1.23	0.36	0.28	20	28	52	C	< 1	0.004
C08100869-003	137	12-19	0.77	31.8	7.0	4.61	2.3	0.5	0.26	26	38	36	CL	< 1	0.005
C08100869-004	138	0-4	0.48	31.0	7.2	3.11	1.14	0.31	0.21	72	12	16	SL	< 1	< 0.002
C08100869-005	138	4-15	0.37	35.2	7.4	2.40	0.82	0.24	0.19	60	16	14	SL	< 1	< 0.002
C08100869-006	139	0-7	4.08	73.3	7.2	27.0	17.7	9.7	2.06	38	32	30	CL	< 1	0.081
C08100869-007	139	7-20	1.98	45.1	7.4	10.8	6.4	4.8	1.65	42	34	24	L	< 1	0.013
C08100869-008	139	20-36	1.23	50.3	7.6	0.05	3.02	3.38	1.64	30	38	32	CL	< 1	0.012
C08100869-009	139	36-46	1.08	87.4	7.7	5.27	3.20	3.25	1.59	12	38	50	C	< 1	0.046
C08100869-010	139	46-60	1.05	67.3	7.7	5.70	3.07	2.23	1.07	18	44	38	SiCL	< 1	0.093
C08100869-011	140	0-9	0.63	54.1	7.0	4.50	1.76	0.16	0.09	52	22	26	SCL	< 1	0.005
C08100869-012	140	9-20	0.38	52.9	7.4	2.75	0.94	0.20	0.15	70	14	16	SL	< 1	0.005
C08100869-013	140	20-35	0.39	33.9	7.5	1.65	0.86	1.05	0.94	64	22	14	SL	< 1	0.004
C08100869-014	140	35-45	0.00	74.3	7.6	2.55	1.8	3.9	2.68	18	24	58	C	< 1	0.033
C08100869-015	140	45-55	1.69	87.2	7.9	6.83	4.6	6.5	2.71	26	20	54	C	< 1	0.155
C08100869-016	140	55-60	4.02	68.5	7.0	27.9	16.2	10.0	2.13	14	16	70	C	16	0.288
C08100869-017	141	0-11	0.85	19.3	7.2	4.30	2.14	0.30	0.17	62	12	26	SCL	5	0.005
C08100869-018	141	11-21	0.46	27.0	7.7	2.68	1.50	0.26	0.16	64	14	22	SCL	4	0.003
C08100869-019	142	0-8	0.59	25.6	7.3	3.81	1.16	0.23	0.15	82	6	12	SL	< 1	< 0.002
C08100869-020	142	8-16	0.58	22.3	7.9	3.88	1.10	0.25	0.16	78	10	12	SL	1	< 0.002
C08100869-021	146	0-9	0.73	47.2	7.4	5.63	1.36	0.59	0.32	25	20	55	C	4	0.026
C08100869-022	146	9-24	3.42	62.4	7.3	26.6	15.2	5.4	1.19	19	28	53	C	16	0.038
C08100869-023	148	0-9	1.19	38.2	7.0	8.13	4.88	0.53	0.21	53	25	22	SCL	3	0.007
C08100869-024	148	9-17	0.59	25.1	7.3	2.76	1.68	0.55	0.37	51	23	26	SCL	4	0.007
C08100869-025	148	17-24	0.53	37.5	8.1	2.44	1.69	0.78	0.54	43	30	27	CL - L	5	0.005
C08100869-026	148	24-37	0.35	29.5	8.2	1.25	1.07	1.02	0.95	63	15	22	SCL	5	0.004
C08100869-027	148	37-60	1.09	35.2	8.3	2.32	2.35	5.25	3.45	53	24	23	SCL	3	0.038
C08100869-028	150	0-5	0.36	28.8	7.3	2.22	0.86	0.34	0.28	73	12	15	SL	2	0.006
C08100869-029	150	5-12	0.24	27.1	7.7	1.62	0.49	0.15	0.15	75	11	14	SL	2	0.003
C08100869-030	150	12-20	0.33	26.6	8.3	2.08	0.67	0.22	0.19	83	8	9	LS	2	0.005
C08100869-031	150	20-35	0.92	15.8	8.4	5.91	2.34	1.33	0.66	81	10	9	LS	2	0.003
C08100869-032	151	0-7	2.74	55.7	7.0	24.7	8.65	3.02	0.74	33	29	38	CL	3	0.009
C08100869-033	151	7-24	0.39	28.1	7.7	1.65	1.10	1.01	0.87	11	39	50	C	11	0.029
C08100869-034	152	0-9	0.58	33.6	7.6	3.90	1.42	0.33	0.21	53	23	24	SCL	3	0.011
C08100869-035	152	9-19	0.38	39.9	7.6	1.72	0.93	0.78	0.68	51	19	30	SCL	3	0.016
C08100869-036	152	19-39	0.52	44.6	8.1	1.50	1.30	2.15	1.82	45	24	31	CL	2	0.008
C08100869-037	152	39-55	0.85	37.4	8.3	1.59	1.40	5.10	4.19	49	23	28	SCL	1	0.014
C08100869-038	152	55-60	1.00	52.7	8.3	1.23	1.43	7.03	6.11	53	13	34	SCL	3	0.025
C08100869-039	153	0-5	0.33	36.7	7.3	1.96	1.02	0.26	0.23	67	16	17	SL	< 1	0.008
C08100869-040	153	5-16	0.30	30.6	7.6	1.84	0.92	0.21	0.18	63	20	17	SL	< 1	0.005

LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**
C08100869-001	137	0-5	0.54	1.8
C08100869-002	137	5-12	0.84	< 0.2
C08100869-003	137	12-19	0.48	0.8
C08100869-004	138	0-4	< 0.43	0.9
C08100869-005	138	4-15	< 0.44	0.6
C08100869-006	139	0-7	3.5	6.6
C08100869-007	139	7-20	1.3	1.5
C08100869-008	139	20-36	1.2	1.6
C08100869-009	139	36-46	1.1	1.0
C08100869-010	139	46-60	0.76	0.6
C08100869-011	140	0-9	0.45	2.1
C08100869-012	140	9-20	< 0.43	1.1
C08100869-013	140	20-35	< 0.43	0.6
C08100869-014	140	35-45	0.61	0.7
C08100869-015	140	45-55	1.1	0.6
C08100869-016	140	55-60	1.7	0.8
C08100869-017	141	0-11	< 0.44	0.8
C08100869-018	141	11-21	< 0.44	0.5
C08100869-019	142	0-8	< 0.43	0.4
C08100869-020	142	8-16	< 0.43	0.5
C08100869-021	146	0-9	0.70	2.1
C08100869-022	146	9-24	0.54	0.9
C08100869-023	146	0-9	< 0.43	1.2
C08100869-024	146	9-17	< 0.44	0.9
C08100869-025	148	17-24	< 0.43	0.7
C08100869-026	148	24-37	< 0.43	0.5
C08100869-027	148	37-60	1.3	0.5
C08100869-028	150	0-5	< 0.44	1.1
C08100869-029	150	5-12	< 0.43	0.9
C08100869-030	150	12-20	< 0.43	0.7
C08100869-031	150	20-35	< 0.43	0.3
C08100869-032	151	0-7	< 0.43	1.4
C08100869-033	151	7-24	< 0.43	0.8
C08100869-034	152	0-9	0.61	1.6
C08100869-035	152	9-19	0.70	1.1
C08100869-036	152	19-39	0.63	0.7
C08100869-037	152	39-55	1.3	0.4
C08100869-038	152	55-60	2.5	0.4
C08100869-039	153	0-5	< 0.43	1.4
C08100869-040	153	5-16	< 0.43	0.7

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

Sample ID	Client Sample ID	Analysis / Units / Depth	EC SatPst mmhos/cm Results	Saturation SatPst % Results	pH SatPst s_u_ Results	Ca SatPst meq/L Results	Mg SatPst meq/L Results	Na SatPst meq/L Results	SAR unitless Results	Sand % Results	Silt % Results	Clay % Results	Texture Results	Coarse Frags % Results	Se-ABDTPA mg/kg-dry Results
C08100869-041	153	16-31	0.58	32.8	8.2	2.45	1.54	1.56	1.11	65	8	27	SCL	2	0.004
C08100869-042	153	31-46	0.60	34.5	8.4	1.14	1.08	3.07	2.92	59	11	30	SCL	4	0.012
C08100869-043	153	46-60	2.01	34.4	8.4	4.53	4.70	9.87	4.59	53	15	32	SCL	1	0.050
C08100869-044	154	0-7	0.86	33.2	7.6	2.92	2.43	2.94	1.80	49	18	33	SCL	2	0.018
C08100869-045	154	7-18	0.83	43.1	7.7	1.33	1.02	1.65	1.52	47	15	38	SC	7	0.009
C08100869-046	154	18-24	2.37	40.1	7.9	2.16	1.65	1.32	0.96	41	20	39	CL	3	0.032
C08100869-047	154	24-36	2.76	53.7	8.0	8.68	7.68	7.31	2.57	29	23	40	C	6	0.090
C08100869-048	155	0-11	0.23	33.3	7.8	1.15	0.73	0.32	0.33	48	18	34	SCL	6	0.006
C08100869-049	155	11-19	0.32	51.8	7.3	1.77	1.06	0.27	0.23	51	14	35	SCL - SC	4	0.004
C08100869-050	155	19-26	0.77	40.7	8.0	3.07	1.83	1.80	1.09	53	17	30	SCL	2	0.005
C08100869-051	155	26-37	0.54	35.7	8.2	1.58	1.17	2.52	2.15	65	8	27	SCL	3	0.006
C08100869-052	155	37-48	0.39	35.6	8.7	0.64	0.41	0.40	0.66	63	13	24	SCL	4	0.016
C08100869-053	155	48-60	1.34	46.3	8.1	5.40	3.91	4.15	1.93	71	7	22	SCL	2	0.078
C08100869-054	156	0-12	0.56	37.0	6.6	2.24	1.44	2.54	1.68	53	17	30	SCL	3	0.009
C08100869-055	156	12-29	1.65	65.0	7.7	5.59	3.60	8.42	3.94	13	27	60	C	8	0.106
C08100869-056	156	29-37	4.63	58.6	7.8	30.4	16.9	16.0	3.31	11	35	54	C	6	0.327
C08100869-057	156	37-53	3.62	45.1	7.6	23.3	12.2	12.0	2.85	33	22	45	C	6	0.229
C08100869-058	156	53-60	2.83	45.2	7.7	14.4	7.63	11.8	3.57	39	24	37	CL	3	0.159
C08100869-059	158	0-12	1.23	44.5	7.1	8.95	3.57	0.53	0.21	33	24	43	C	5	0.012
C08100869-060	158	12-25	0.81	39.8	7.6	6.11	2.57	0.50	0.24	39	25	36	CL	3	0.012
C08100869-061	158	25-33	0.44	34.4	7.9	3.02	1.40	0.49	0.33	61	19	20	SL - SCL	5	0.010
C08100869-062	158	33-48	0.59	27.2	8.0	2.70	1.61	1.85	1.26	63	15	22	SCL	2	0.014
C08100869-063	158	48-60	0.99	28.3	8.1	3.43	2.37	4.34	2.56	88	2	10	LS	1	0.000
C08100869-064	159	0-14	0.54	41.3	7.4	2.94	1.83	1.30	0.84	27	23	50	C	3	0.010
C08100869-065	159	14-28	1.63	44.7	7.9	6.89	5.24	5.28	2.15	31	27	42	C	4	0.031
C08100869-066	159	28-37	2.84	42.8	8.1	14.7	11.5	7.50	2.10	45	23	32	CL	5	0.069
C08100869-067	159	37-60	1.93	26.6	8.1	8.22	5.55	6.50	2.48	49	21	30	SCL	5	0.111
C08100869-068	160	0-13	0.48	39.5	7.5	3.04	1.86	0.96	0.61	33	33	34	CL	4	0.011
C08100869-069	160	13-21	0.69	37.9	8.1	3.00	1.88	2.70	1.73	33	27	40	C - CL	5	0.011
C08100869-070	160	21-33	1.92	33.4	8.1	8.86	5.76	6.63	2.46	39	25	36	CL	3	0.000
C08100869-071	160	33-55	1.71	42.3	8.1	7.14	4.31	6.03	2.53	25	33	42	C	4	0.103
C08100869-072	160	55-60	1.30	44.1	8.1	4.98	2.96	4.83	2.43	33	27	40	C - CL	4	0.086
C08100869-073	161	0-12	0.48	43.4	7.7	2.15	1.51	1.93	1.43	41	21	38	CL	3	0.010
C08100869-074	161	12-28	2.43	40.8	7.4	8.64	6.8	9.8	3.54	31	26	43	C	4	0.099
C08100869-075	161	28-46	5.44	41.3	7.5	21.5	14.4	10.6	2.50	27	29	44	C	6	0.265
C08100869-076	161	46-60	4.23	25.2	7.6	25.0	15.3	14.3	3.20	61	15	24	SCL	3	0.069
C08100869-077	162	0-12	0.47	35.9	7.2	2.68	1.40	0.85	0.60	29	31	40	C - CL	4	0.018
C08100869-078	163	0-7	1.22	30.5	7.4	8.84	3.97	1.08	0.43	25	35	40	C - CL	4	0.013
C08100869-079	163	7-20	3.73	39.8	7.8	20.9	15.1	13.5	3.19	23	41	36	CL	7	0.027
C08100869-080	163	20-29	7.98	38.9	8.2	17.1	38.8	55.0	10.5	22	58	20	SiL	6	0.074

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	Client Sample ID	Depth	Results	Results
C08100869-041	153	16-31	< 0.43	0.7
C08100869-042	153	31-46	0.58	0.4
C08100869-043	153	46-60	1.7	0.4
C08100869-044	154	0-7	0.59	1.0
C08100869-045	154	7-18	0.59	0.7
C08100869-046	154	18-24	0.70	0.5
C08100869-047	154	24-36	0.95	0.4
C08100869-048	155	0-11	< 0.43	1.0
C08100869-049	155	11-19	0.45	0.8
C08100869-050	155	19-26	0.65	0.7
C08100869-051	155	26-37	0.73	0.5
C08100869-052	155	37-48	1.2	0.4
C08100869-053	155	48-60	0.92	0.2
C08100869-054	156	0-12	< 0.44	0.9
C08100869-055	156	12-29	1.4	0.6
C08100869-056	156	29-37	1.8	0.5
C08100869-057	156	37-53	0.92	0.4
C08100869-058	156	53-60	0.55	0.4
C08100869-059	158	0-12	0.67	1.4
C08100869-060	158	12-25	0.78	0.6
C08100869-061	158	25-33	< 0.44	0.4
C08100869-062	158	33-48	0.45	0.5
C08100869-063	158	48-60	< 0.44	0.3
C08100869-064	159	0-14	0.63	1.1
C08100869-065	159	14-28	1.4	0.8
C08100869-066	159	28-37	1.3	0.5
C08100869-067	159	37-60	0.63	0.4
C08100869-068	160	0-13	< 0.43	1.3
C08100869-069	160	13-21	0.61	0.8
C08100869-070	160	21-33	0.90	0.6
C08100869-071	160	33-55	0.76	0.4
C08100869-072	160	55-60	0.64	0.5
C08100869-073	161	0-12	0.54	0.9
C08100869-074	161	12-28	1.5	0.7
C08100869-075	161	28-46	1.5	0.2
C08100869-076	161	46-60	0.49	< 0.2
C08100869-077	162	0-12	< 0.43	0.6
C08100869-078	163	0-7	0.53	1.0
C08100869-079	163	7-20	0.50	0.9
C08100869-080	163	20-29	2.1	0.2

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LABORATORY ANALYTICAL REPORT

Client: DKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Sand	Silt	Clay	Texture	Coarse Frags	Se-ABDTPA
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/l	unitless	%	%	%		%	mg/kg-dry
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C08100869-081	163	29-37	12.1	41.0	8.3	10.8	65.4	93.6	14.4	61	19	20	SL - SCL	4	0.055
C08100869-082	163	37-50	15.0	35.0	8.3	24.8	86.3	121	16.3	63	15	22	SCL	5	0.045
C08100869-083	163	50-60	14.6	34.2	8.3	22.6	84.5	118	16.2	88	2	10	LS	5	0.035
C08100869-084	164	0-10	1.62	32.0	7.3	10.8	6.41	1.96	0.67	27	23	50	C	2	0.012
C08100869-085	164	10-20	0.53	28.9	7.9	2.76	1.98	1.02	0.66	31	27	42	C	3	0.008
C08100869-086	164	20-34	0.95	39.4	8.0	1.99	2.51	4.97	3.32	45	23	32	CL	8	0.077
C08100869-087	165	0-17	0.66	36.6	7.9	4.36	2.97	0.60	0.31	49	21	30	SCL	4	0.016
C08100869-088	165	17-27	0.64	37.1	8.4	1.80	2.88	2.43	1.59	33	33	34	CL	4	0.017
C08100869-089	165	27-36	1.74	29.8	8.4	1.67	4.34	6.96	4.04	33	27	40	C - CL	3	0.024
C08100869-090	165	36-48	5.12	31.6	8.2	19.5	32.5	20.3	4.01	30	25	36	CL	8	0.125
C08100869-091	165	48-60	6.11	31.6	8.2	20.0	40.5	27.9	5.09	25	33	42	C	< 1	0.276
C08100869-092	166	0-7	0.91	21.1	7.6	6.42	2.58	0.55	0.26	33	27	40	C - CL	4	0.008
C08100869-093	166	7-21	0.48	26.8	7.9	3.56	1.06	0.37	0.24	41	21	38	CL	4	0.005
C08100869-094	166	21-36	0.49	21.4	8.2	3.14	1.22	0.72	0.49	31	26	43	C	4	0.008
C08100869-095	166	36-48	0.09	20.1	7.8	4.21	2.32	0.90	0.50	27	29	44	C	2	0.006
C08100869-096	168	0-9	0.40	35.7	6.2	2.72	1.17	0.23	0.17	61	15	24	SCL	3	0.007
C08100869-097	168	9-29	0.22	29.0	6.6	0.87	0.37	0.11	0.13	29	31	40	C - CL	3	0.009
C08100869-098	168	29-41	0.23	27.0	6.9	1.58	0.65	0.21	0.20	25	35	40	C - CL	3	0.003
C08100869-099	168	41-51	0.30	26.3	7.0	1.86	0.86	0.39	0.34	23	41	36	CL	1	0.006
C08100869-100	168	51-60	0.20	25.8	7.0	1.15	0.54	0.30	0.33	22	58	20	SiL	3	0.008
C08100869-101	170	0-9	0.58	31.3	6.9	3.18	2.34	0.68	0.41	63	3	34	SCL	4	0.006
C08100869-102	170	9-29	0.07	33.7	7.8	2.65	2.68	1.87	1.15	33	37	30	CL	3	0.008
C08100869-103	170	29-40	1.27	31.1	8.1	3.77	4.88	5.35	2.58	45	23	32	CL	4	0.028
C08100869-104	170	40-60	3.90	35.4	7.9	20.3	16.5	12.6	2.60	30	29	32	CL	4	0.130
C08100869-105	171	0-7	0.74	36.2	7.6	5.02	2.80	0.66	0.34	33	31	36	CL	5	0.009
C08100869-106	172	0-12	0.40	21.4	7.1	3.12	1.46	0.21	0.14	61	17	22	SCL	2	0.009
C08100869-107	172	12-19	0.30	23.6	7.5	2.06	1.00	0.24	0.19	71	11	18	SL	2	0.008
C08100869-108	172	19-29	0.46	34.5	7.6	2.94	1.63	0.93	0.62	81	5	14	SL	4	0.007
C08100869-109	173	0-15	0.52	29.8	7.0	4.32	1.50	0.15	0.09	65	11	24	SCL	< 1	0.006
C08100869-110	173	15-31	0.42	31.9	8.0	2.20	2.01	0.15	0.10	59	17	24	SCL	< 1	0.004
C08100869-111	173	31-37	0.57	30.7	7.9	2.32	3.09	0.20	0.12	53	27	20	SL - SCL	< 1	0.004
C08100869-112	173	37-55	0.43	29.4	7.8	1.81	2.29	0.20	0.14	69	13	18	SL	1	0.004
C08100869-113	173	55-60	0.65	28.4	7.2	2.53	2.69	0.20	0.12	39	39	22	L	5	0.005
C08100869-114	174	0-3	0.51	38.4	7.1	3.88	1.50	0.28	0.17	33	35	32	CL	3	0.008
C08100869-115	174	3-10	0.43	40.5	7.5	2.58	0.79	1.24	0.95	29	27	44	C	3	0.006
C08100869-116	174	10-20	0.62	46.0	7.0	1.48	0.57	4.43	4.40	27	27	46	C	3	0.008
C08100869-117	174	20-36	5.45	48.3	7.6	32.4	13.6	22.9	4.78	29	21	50	C	3	0.132
C08100869-118	174	36-48	7.30	43.5	7.6	42.4	18.1	30.5	5.56	27	41	32	CL	3	0.716
C08100869-119	175	0-4	7.24	24.5	6.7	8.98	2.8	1.4	0.58	92	< 1	8	S	< 1	0.710
C08100869-120	175	4-17	1.24	32.0	6.9	3.67	1.71	0.56	0.34	51	17	32	SCL	10	0.009

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

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		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	Client Sample ID	Depth	Results	Results
C08100869-081	163	29-37	2.4	< 0.2
C08100869-082	163	37-50	1.2	< 0.2
C08100869-083	163	50-60	1.1	< 0.2
C08100869-084	164	0-10	0.44	0.8
C08100869-085	164	10-20	< 0.43	1.0
C08100869-086	164	20-34	0.59	0.6
C08100869-087	165	0-17	< 0.43	1.2
C08100869-088	165	17-27	0.52	0.5
C08100869-089	165	27-36	0.89	0.4
C08100869-090	165	36-48	2.2	0.4
C08100869-091	165	48-60	2.8	0.4
C08100869-092	166	0-7	< 0.44	1.0
C08100869-093	166	7-21	< 0.43	0.8
C08100869-094	166	21-36	< 0.43	0.4
C08100869-095	166	36-48	< 0.43	0.3
C08100869-096	168	0-9	< 0.43	4.0
C08100869-097	168	9-29	< 0.43	1.4
C08100869-098	168	29-41	< 0.43	1.1
C08100869-099	168	41-51	< 0.43	< 0.2
C08100869-100	168	51-60	< 0.43	0.5
C08100869-101	170	0-9	< 0.43	1.4
C08100869-102	170	9-29	0.75	0.8
C08100869-103	170	29-40	0.92	0.4
C08100869-104	170	40-60	1.8	0.4
C08100869-105	171	0-7	0.57	2.2
C08100869-106	172	0-12	< 0.44	1.1
C08100869-107	172	12-19	< 0.43	0.7
C08100869-108	172	19-29	< 0.43	0.6
C08100869-109	173	0-15	0.46	0.9
C08100869-110	173	15-31	< 0.44	0.5
C08100869-111	173	31-37	< 0.43	0.0
C08100869-112	173	37-55	< 0.43	0.5
C08100869-113	173	55-60	< 0.44	0.5
C08100869-114	174	0-3	0.51	2.5
C08100869-115	174	3-10	< 0.43	1.4
C08100869-116	174	10-20	0.59	1.0
C08100869-117	174	20-36	1.5	0.8
C08100869-118	174	36-48	1.2	0.8
C08100869-119	175	0-4	0.69	1.1
C08100869-120	175	4-17	0.75	1.2

LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Sand	Silt	Clay	Texture	Coarse Frags	Se-ABDTPA
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	%	%	%		%	mg/kg-dry
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C08100869-121	175	17-33	0.59	40.9	7.3	1.81	0.87	0.68	0.59	53	15	32	SCL	6	0.009
C08100869-122	175	33-41	0.32	40.6	7.7	1.30	0.65	1.81	1.84	69	11	20	SL - SCL	3	< 0.002
C08100869-123	175	41-48	0.62	39.6	8.0	1.67	0.85	3.55	3.17	51	15	34	SCL	11	< 0.002
C08100869-124	177	0-2	0.33	28.9	7.0	2.20	1.05	0.29	0.23	47	23	30	SCL	6	0.009
C08100869-125	177	2-15	0.19	31.5	6.8	1.25	0.51	0.22	0.24	41	25	34	CL	6	0.006
C08100869-126	178	0-2	0.30	29.1	6.8	1.70	0.85	0.11	0.10	69	19	12	SL	3	0.002
C08100869-127	178	2-12	0.32	24.7	7.2	1.91	0.92	0.16	0.13	71	11	18	SL	3	0.003
C08100869-128	178	12-18	0.15	24.3	7.2	1.02	0.48	0.16	0.19	63	19	18	SL	4	0.004
C08100869-129	178	18-29	0.28	25.0	7.7	1.81	0.79	0.28	0.24	73	3	24	SCL	2	< 0.002
C08100869-130	178	29-35	0.29	24.9	7.0	1.58	0.90	0.32	0.29	81	4	15	SL	2	< 0.002
C08100869-131	178	35-60	0.47	23.5	8.0	2.56	1.66	0.56	0.38	78	6	16	SL	3	< 0.002
C08100869-132	180	0-2	0.53	51.2	8.1	4.14	1.60	0.11	0.07	21	33	46	C	3	0.007
C08100869-133	180	2-12	0.39	40.4	6.8	2.90	0.95	0.26	0.19	37	23	40	C - CL	5	0.018
C08100869-134	180	12-19	0.72	49.8	6.8	6.18	2.03	0.71	0.35	33	29	38	CL	3	0.006
C08100869-135	180	19-37	1.22	34.4	7.2	9.67	3.44	0.89	0.35	41	23	36	CL	3	0.010
C08100869-136	181	0-2	0.51	30.8	6.7	3.94	1.60	0.50	0.30	63	13	24	SCL	1	0.006
C08100869-137	181	2-9	0.29	28.5	6.8	2.21	0.77	0.19	0.15	71	11	18	SL	3	0.004
C08100869-138	181	9-21	0.34	25.0	7.2	2.60	0.93	0.22	0.16	73	7	20	SL - SCL	3	0.002
C08100869-139	182	0-2	0.56	26.8	6.8	4.59	1.89	0.10	0.06	79	7	14	SL	< [illegible]	0.005
C08100869-140	182	2-15	0.21	27.0	7.2	1.10	0.49	0.28	0.31	82	2	16	SL	< [illegible]	0.003
C08100869-141	182	15-30	0.23	29.0	7.8	1.58	0.63	0.16	0.15	80	8	12	SL	< [illegible]	< 0.002
C08100869-142	182	30-44	0.23	31.3	7.9	0.96	0.59	0.47	0.54	74	12	14	SL	< [illegible]	0.002
C08100869-143	183	0-8	0.81	39.0	7.2	6.94	2.19	1.17	0.55	38	32	30	CL	3	0.012
C08100869-144	183	8-22	1.04	44.4	7.6	4.25	2.15	5.46	3.06	26	50	24	SiL - L	5	0.021
C08100869-145	184	0-8	0.33	34.8	7.1	2.86	0.72	0.22	0.17	54	26	20	SL - SCL	4	0.012
C08100869-146	184	8-17	0.44	35.7	7.2	3.61	1.18	0.29	0.19	42	28	30	CL	4	0.010
C08100869-147	185	0-2	0.60	31.0	7.2	4.30	1.98	0.23	0.13	62	24	14	SL	2	0.008
C08100869-148	185	2-19	0.35	29.7	7.0	2.25	1.13	0.22	0.17	61	17	22	SCL	2	0.006
C08100869-149	185	19-31	0.51	30.1	7.5	2.72	1.61	0.07	0.66	60	14	26	SCL	3	0.005
C08100869-150	185	31-48	0.68	23.4	7.6	2.64	1.72	2.41	1.64	70	10	20	SL - SCL	2	0.008
C08100869-151	186	0-8	0.67	25.7	7.6	2.73	1.72	2.33	1.66	28	42	30	CL	3	0.023
C08100869-152	186	8-18	0.49	34.1	7.0	4.01	1.81	0.28	0.16	48	20	32	SCL	5	0.015
C08100869-153	186	18-31	0.52	32.0	6.0	3.88	1.39	0.28	0.17	34	34	32	CL	5	0.016
C08100869-154	186	31-43	0.61	30.4	7.5	4.85	1.45	0.60	0.34	52	22	26	SCL	3	0.022
C08100869-155	186	43-60	0.79	32.2	7.0	6.20	2.30	0.63	0.31	50	20	30	SCL	3	0.027
C08100869-156	187	0-8	0.55	43.8	7.2	2.57	0.90	2.61	1.99	24	26	50	C	6	0.016
C08100869-157	187	8-17	2.08	55.1	7.5	10.1	4.00	9.70	3.66	18	30	52	C	6	0.052
C08100869-158	187	17-22	0.63	30.8	7.1	5.12	1.80	0.49	0.26	12	38	50	C	20	0.087
C08100869-159	188	0-9	0.36	20.6	7.6	2.64	1.14	0.19	0.14	62	18	20	SL - SCL	3	0.005
C08100869-160	188	9-21	0.37	29.4	8.0	1.96	1.45	0.56	0.43	72	8	20	SL - SCL	4	< 0.002

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

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		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	Client Sample ID	Depth	Results	Results
C08100869-121	175	17-33	< 0.44	0.7
C08100869-122	175	33-41	< 0.43	0.6
C08100869-123	175	41-48	< 0.43	0.2
C08100869-124	177	0-2	< 0.43	2.6
C08100869-125	177	2-15	< 0.43	1.4
C08100869-126	178	0-2	< 0.43	2.6
C08100869-127	178	2-12	< 0.44	1.2
C08100869-128	178	12-18	0.61	0.0
C08100869-129	178	18-29	< 0.44	0.6
C08100869-130	178	29-35	< 0.43	0.3
C08100869-131	178	35-60	< 0.43	0.5
C08100869-132	180	0-2	0.62	5.1
C08100869-133	180	2-12	0.58	1.7
C08100869-134	180	12-19	0.75	1.1
C08100869-135	180	19-37	0.76	1.1
C08100869-136	181	0-2	< 0.44	1.6
C08100869-137	181	2-9	< 0.43	1.0
C08100869-138	181	9-21	0.61	0.5
C08100869-139	182	0-2	< 0.44	1.6
C08100869-140	182	2-15	< 0.43	0.3
C08100869-141	182	15-30	< 0.43	0.2
C08100869-142	182	30-44	< 0.43	< 0.2
C08100869-143	183	0-8	0.47	2.3
C08100869-144	183	8-22	0.64	1.3
C08100869-145	184	0-8	< 0.43	1.2
C08100869-146	184	8-17	< 0.43	0.9
C08100869-147	185	0-2	< 0.43	2.4
C08100869-148	185	2-19	< 0.43	0.8
C08100869-149	185	19-31	< 0.43	0.9
C08100869-150	185	31-48	0.44	0.3
C08100869-151	186	0-8	0.64	2.4
C08100869-152	186	8-18	0.49	1.2
C08100869-153	186	18-31	0.57	1.1
C08100869-154	186	31-43	< 0.43	1.0
C08100869-155	186	43-60	< 0.43	0.9
C08100869-156	187	0-8	0.54	1.2
C08100869-157	187	0-17	0.70	1.0
C08100869-158	187	17-22	< 0.43	0.6
C08100869-159	188	0-9	< 0.43	1.0
C08100869-160	188	9-21	< 0.43	0.6

LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

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Sample ID	Client Sample ID	Analysis / Units / Depth	EC SatPst mmhos/cm Results	Saturation SatPst % Results	pH SatPst s_u_ Results	Ca SatPst meq/L Results	Mg SatPst meq/L Results	Na SatPst meq/L Results	SAR unitless Results	Sand % Results	Silt % Results	Clay % Results	Texture Results	Coarse Frags % Results	Se-ABDTPA mg/kg-dry Results
C08100869-161	188	21-30	1.11	28.2	8.2	0.56	0.27	11.3	17.7	61	9	30	SCL	3	< 0.002
C08100869-162	188	30-48	0.57	37.4	7.0	0.67	1.55	4.40	4.19	65	7	28	SCL	5	< 0.002
C08100869-163	189	0-8	1.73	40.2	7.6	0.29	0.97	18.8	23.0	40	13	38	SC	5	0.006
C08100869-164	189	8-18	0.58	38.2	8.0	0.42	1.26	4.15	4.55	51	19	30	SCL	4	0.004
C08100869-165	189	18-24	2.17	26.7	7.3	0.31	2.39	23.9	20.7	33	33	34	CL	7	0.003
C08100860-166	190	0-3	1.14	30.6	7.3	0.31	0.93	11.4	14.6	69	19	12	SL	3	0.004
C08100869-167	190	3-14	0.81	28.9	7.9	0.49	0.93	7.18	8.54	61	11	28	SCL	3	0.003
C08100869-168	190	14-38	3.34	28.2	7.6	5.09	12.9	18.1	5.97	69	9	22	SCL	5	0.007
C08100869-169	190	38-48	0.50	31.5	7.4	0.54	0.96	4.08	4.73	61	17	22	SCL	2	0.075
C08100869-170	191	0-3	0.41	30.7	7.5	0.42	0.32	2.57	4.24	69	11	20	SL - SCL	1	< 0.002
C08100869-171	191	3-11	0.40	20.7	7.6	0.32	0.31	3.23	5.82	77	7	16	SL	3	0.007
C08100869-172	191	11-18	0.38	27.8	8.1	0.31	0.32	3.04	5.41	71	13	16	SL	1	0.006
C08100869-173	191	18-34	0.37	26.3	8.1	0.42	0.33	2.77	4.52	73	7	20	SL - SCL	6	0.006
C08100869-174	192	0-1	0.42	31.2	7.1	0.56	0.41	3.45	4.96	43	25	32	CL	6	0.006
C08100869-175	192	1-8	0.47	46.7	7.3	0.39	0.34	4.00	6.87	19	35	46	C	12	0.008
C08100860-176	193	0-3	2.12	27.8	6.6	5.66	2.79	0.44	0.21	45	25	30	CL	3	0.005
C08100869-177	193	3-10	0.45	36.5	7.5	3.10	1.59	0.61	0.40	25	31	44	C	6	0.009
C08100869-178	193	10-18	0.60	40.7	7.9	2.06	1.47	3.20	2.42	31	39	30	CL	4	0.010
C08100869-179	193	18-36	2.64	38.2	8.0	5.70	4.89	17.3	7.55	29	39	32	CL	5	0.173
C08100869-180	193	36-60	7.32	43.5	7.8	26.0	26.7	43.3	8.17	29	21	50	C	6	0.565
C08100869-181	194	0-8	0.02	37.1	7.5	6.35	2.96	1.31	0.61	38	22	40	C - CL	7	0.011
C08100869-182	194	8-17	0.48	39.2	8.0	3.28	2.21	0.42	0.26	24	42	34	CL	5	0.010
C08100869-183	194	17-32	0.72	35.7	8.4	1.04	2.32	3.07	2.76	26	38	36	CL	6	0.008
C08100869-184	194	32-44	7.09	37.6	8.1	28.9	44.5	30.6	5.07	30	30	40	C - CL	7	0.242
C08100869-185	195	0-9	1.54	21.4	7.3	9.67	5.61	1.87	0.68	74	16	10	SL	3	0.006
C08100869-186	195	9-18	0.52	21.0	7.4	3.76	1.55	0.29	0.18	72	12	16	SL	5	0.005
C08100869-187	195	18-37	0.55	21.2	7.8	4.16	1.46	0.35	0.21	74	14	12	SL	4	0.004
C08100869-188	195	37-48	0.55	21.7	8.0	3.06	1.93	0.31	0.20	73	13	14	SL	5	0.009
C08100860-189	197	0-4	0.85	22.3	7.1	2.47	1.12	0.08	0.06	64	22	14	SL	4	0.013
C08100869-190	197	4-10	0.26	24.0	7.3	1.73	0.82	0.18	0.16	70	6	24	SCL	9	0.013
C08100869-191	197	10-19	0.28	21.9	7.6	1.61	0.83	0.25	0.23	74	10	16	SL	3	0.008
C08100869-192	197	19-36	0.36	19.6	8.2	2.00	1.09	0.37	0.30	90	< 1	10	LS	2	0.007
C08100869-193	197	36-48	0.47	18.5	8.3	2.13	1.75	1.01	0.73	92	2	6	S	2	0.010
C08100869-194	198	0-6	0.34	21.2	6.6	1.95	1.08	0.44	0.36	66	20	14	SL	3	0.013
C08100869-195	198	6-22	0.50	24.7	7.4	2.76	1.97	0.49	0.32	54	26	20	SL - SCL	2	0.013
C08100869-196	199	0-3	0.72	28.7	6.0	3.86	1.72	0.13	0.08	52	26	22	SCL	4	0.015
C08100869-197	199	3-14	0.70	42.9	6.6	2.11	0.85	0.14	0.12	58	26	16	SL	4	0.016
C08100869-198	199	14-26	0.27	24.0	7.1	1.67	0.76	0.20	0.18	54	18	28	SCL	3	0.009
C08100869-199	199	26-43	0.17	30.3	7.2	1.00	0.45	0.23	0.27	56	14	30	SCL	2	0.010
C08100869-200	199	43-60	0.25	24.2	7.4	1.55	0.72	0.28	0.27	52	26	22	SCL	3	0.007

LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	Client Sample ID	Depth	Results	Results
C08100869-161	188	21-30	< 0.43	0.5
C08100869-162	188	30-40	< 0.44	0.4
C08100869-163	189	0-8	< 0.43	1.8
C08100869-164	189	8-18	< 0.44	1.0
C08100869-165	189	18-24	< 0.43	0.6
C08100869-166	190	0-3	< 0.43	2.6
C08100869-167	190	3-14	< 0.43	0.9
C08100869-168	190	14-38	0.50	0.6
C08100869-169	190	38-48	1.2	0.3
C08100869-170	191	0-3	< 0.44	2.4
C08100869-171	191	3-11	< 0.43	0.9
C08100869-172	191	11-18	< 0.43	0.5
C08100869-173	191	18-34	< 0.43	0.4
C08100869-174	192	0-1	< 0.44	1.2
C08100869-175	192	1-8	< 0.44	1.0
C08100869-176	193	0-3	< 0.43	1.7
C08100869-177	193	3-10	< 0.43	1.1
C08100869-178	193	10-18	0.51	0.7
C08100869-179	193	18-36	1.1	0.5
C08100869-180	193	36-60	0.74	0.4
C08100869-181	194	0-8	< 0.43	2.4
C08100869-182	194	8-17	< 0.43	1.6
C08100869-183	194	17-32	0.45	0.7
C08100869-184	194	32-44	2.0	0.6
C08100869-185	195	0-9	< 0.43	0.8
C08100869-186	195	9-18	< 0.43	0.7
C08100869-187	195	18-37	< 0.43	0.5
C08100869-188	195	37-48	0.64	0.3
C08100869-189	197	0-4	0.49	1.7
C08100869-190	197	4-10	0.68	0.8
C08100869-191	197	10-19	< 0.43	0.8
C08100869-192	197	19-36	< 0.43	0.2
C08100869-193	197	36-48	0.63	< 0.2
C08100869-194	198	0-6	0.58	0.9
C08100869-195	198	6-22	0.72	1.1
C08100869-196	199	0-3	0.44	5.1
C08100869-197	199	3-14	< 0.43	1.5
C08100869-198	199	14-26	< 0.43	1.1
C08100869-199	199	26-43	< 0.43	0.7
C08100869-200	199	43-60	< 0.44	1.0

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Sand	Silt	Clay	Texture	Coarse Frags	Se-ABDTPA
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	%	%	%		%	mg/kg-dry
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C08100869-201	201	0-2	0.51	27.4	7.1	3.16	2.06	0.14	0.09	60	20	20	SL - SCL	6	0.009
C08100869-202	201	2-10	0.50	37.2	7.5	2.94	2.22	0.45	0.28	62	< 1	38	SC	8	0.012
C08100869-203	201	10-31	0.49	30.7	8.2	2.23	2.75	2.06	1.31	40	26	34	CL	4	0.010
C08100869-204	201	31-42	1.09	29.9	8.3	2.68	3.47	4.96	2.84	44	26	30	CL	4	0.034
C08100869-205	201	42-48	4.20	32.1	8.1	23.2	21.3	13.0	2.76	46	22	32	SCL	4	0.094
C08100869-206	202	0-4	0.65	40.7	7.1	4.58	2.33	0.47	0.25	20	36	44	C	1	0.005
C08100869-207	202	4-17	0.58	46.4	7.6	4.24	1.43	0.85	0.50	14	42	44	SiC	12	0.007
C08100869-208	202	17-27	1.52	40.2	8.0	9.82	3.73	3.42	1.32	46	30	24	L	6	0.044
C08100869-209	202	27-36	3.02	36.8	7.4	22.2	11.2	6.35	1.56	48	26	26	SCL	9	0.218
C08100869-210	202	36-48	3.17	25.6	7.6	23.2	13.2	5.66	1.33	62	18	20	SL - SCL	3	0.151
C08100869-211	203	0-2	0.56	38.5	7.6	2.88	1.81	1.58	1.03	40	22	38	CL	4	0.012
C08100869-212	203	2-8	0.44	41.7	7.6	2.29	1.35	1.07	0.80	46	18	36	SC	6	0.007
C08100869-213	203	8-21	0.97	47.6	8.0	2.84	1.99	5.24	3.38	30	26	44	C	4	0.034
C08100869-214	203	21-40	5.59	48.6	7.9	28.8	20.6	24.4	4.93	28	46	26	L	9	0.347
C08100869-215	204	0-9	0.81	34.8	7.6	5.78	2.56	0.74	0.36	54	24	22	SCL	5	0.008
C08100869-216	204	9-22	0.57	31.4	8.2	3.10	1.86	1.11	0.70	60	20	20	SL - SCL	10	0.007
C08100869-217	204	22-29	3.68	32.3	8.4	22.3	14.6	11.3	2.63	62	14	24	SCL	3	0.073
C08100869-218	204	29-48	1.59	22.4	8.4	7.89	4.00	4.83	1.99	88	< 1	12	LS	< 1	0.018

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LABORATORY ANALYTICAL REPORT

Client: BKS Environmental Associates Inc
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	B-CACL2	Organic Matter
		Units	mg/kg-dry	%
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**
C08100869-201	201	0-2	< 0.43	2.3
C08100869-202	201	2-10	< 0.43	1.2
C08100869-203	201	10-31	< 0.43	0.8
C08100869-204	201	31-42	0.72	0.5
C08100869-205	201	42-48	1.2	0.3
C08100869-206	202	0-4	0.52	2.4
C08100869-207	202	4-17	< 0.43	1.6
C08100869-208	202	17-27	0.48	1.0
C08100869-209	202	27-36	0.97	1.2
C08100869-210	202	36-48	0.48	0.6
C08100869-211	203	0-2	0.74	1.3
C08100869-212	203	2-8	0.52	1.2
C08100869-213	203	8-21	1.9	0.9
C08100869-214	203	21-40	1.9	0.7
C08100869-215	204	0-9	0.45	1.4
C08100869-216	204	9-22	0.68	0.4
C08100869-217	204	22-29	1.6	0.7
C08100869-218	204	29-48	0.65	0.9

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PSA Texture

Method: ASA mono # 9 15-5.2

Batch ID: 1.00
Date Started: 12/24/08

Test Code: PSA-TEXTURE-S
Analyst: CAYLAH

Sample #	40 Sec Read	40 Sec Temp °C	8 Hour Read	8 Hour Temp °C	Recheck Sand	Recheck Silt	Recheck Clay	Recheck Texture	Original Sand	Original Silt	Original Clay	Original Texture
1	6.00	17.0	5.00	22.5								
1												
C08100869-001 A	41.5	17.0	22.0	22.5	29	37	34	CL	30	36	34	CL
C08100869-002 A	54.0	17.0	36.0	22.5	4	34	62	C	20	28	52	C
C08100869-003 A	50.0	17.0	31.0	22.5	12	36	52	C	26	38	36	CL
C08100869-088 A	42.0	17.0	27.0	22.5	28	28	44	C	45	25	30	CL
C08100869-090 A	40.5	17.0	25.5	22.5	31	28	41	C	33	37	30	CL
C08100869-091 A	32.0	17.0	20.0	22.5	48	22	30	SCL	43	21	36	C
C08100869-092 A	23.0	17.0	17.0	22.5	66	10	24	SCL	81	9	10	C - CL
C08100869-094 A	18.0	17.0	15.0	22.5	76	4	20	SL - SCL	83	3	14	C
C08100869-095 A	21.0	17.0	16.5	22.5	70	7	23	SCL	87	1	12	C
C08100869-097 A	35.0	17.0	19.5	22.5	42	29	29	CL	51	31	18	C - CL
C08100869-098 A	32.0	17.0	13.0	22.5	48	36	16	L	51	33	16	C - CL
C08100869-103 A	37.0	17.0	27.0	22.5	38	18	44	C	45	23	32	CL
C08100869-104 A	39.0	17.0	27.0	22.5	34	22	44	C	39	29	32	CL
C08100869-129 A	21.0	17.0	16.0	22.5	70	8	22	SCL	73	3	24	SCL
C08100869-138 A	23.0	17.0	19.0	22.5	66	6	28	SCL	73	7	20	SL - SCL
C08100869-165 A	43.0	17.0	22.0	22.5	26	40	34	CL	33	33	34	CL
C08100869-168 A	27.0	17.0	22.0	22.5	58	8	34	SCL	69	9	22	SCL
C08100869-210 A	26.0	17.0	12.0	22.5	60	26	14	SL	62	18	20	SL - SCL

PSA Texture

Method: ASA mono # 9 15-5.2

Batch ID: 1.00
Date Started: 12/31/08

Test Code: PSA-TEXTURE-S
Analyst: Missy Linda

					Recheck				Original			
Sample #	40 Sec Read	40 Sec Temp °C	8 Hour Read	8 Hour Temp °C	Sand	Silt	Clay	Texture	Sand	Silt	Clay	Texture
1	6.00	19.0	5.00	23.0								
1												
C08100869-017 A	25.0	19.0	18.0	23.0	62	12	26	SCL	62	12	26	SCL
C08100869-018 A	24.5	19.0	15.5	23.0	66	13	21	SCL	64	14	22	SCL
C08100869-024 A	33.0	19.0	17.0	23.0	49	27	24	SCL	51	23	26	SCL
C08100869-025 A	36.5	19.0	20.0	23.0	42	28	30	CL	43	30	27	CL - L
C08100869-026 A	27.0	19.0	15.0	23.0	61	19	20	SL - SCL	63	15	22	SCL
C08100869-027 A	32.0	19.0	17.5	23.0	51	24	25	SCL	53	24	23	SCL
C08100869-053 A	23.0	19.0	15.0	23.0	69	11	20	SL - SCL	71	7	22	SCL
C08100869-061 A	29.5	19.0	16.0	23.0	56	22	22	SCL	61	19	20	SL - SCL
C08100869-062 A	31.0	19.0	15.0	23.0	53	27	20	SL - SCL	63	15	22	SCL
C08100869-076 A	27.0	19.0	16.0	23.0	61	17	22	SCL	61	15	24	SCL
C08100869-078 A	47.0	19.0	23.0	23.0	21	43	36	CL	25	35	40	C - CL
C08100869-079 A	46.5	19.0	22.5	23.0	22	43	35	CL	23	41	36	CL
C08100869-084 A	34.0	19.0	19.5	23.0	47	24	29	SCL	27	23	50	C
C08100869-085 A	38.0	19.0	20.0	23.0	39	31	30	CL	31	27	42	C
C08100869-086 A	39.5	19.0	13.0	23.0	36	48	16	L	45	23	32	CL
C08100869-099 A	28.5	19.0	13.5	23.0	58	25	17	SL	23	41	36	CL
C08100869-100 A	27.5	19.0	13.0	23.0	60	24	16	SL	22	58	20	SiL
C08100869-106 A	26.5	19.0	15.0	23.0	62	18	20	SL - SCL	61	17	22	SCL
C08100869-109 A	26.0	19.0	14.5	23.0	63	18	19	SL	65	11	24	SCL
C08100869-110 A	26.0	19.0	15.0	23.0	63	17	20	SL - SCL	59	17	24	SCL

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

Sample ID	Client Sample ID	Analysis / Units / Depth	Sand % Results	Silt % Results	Clay % Results	Texture Results	Coarse Frags % Results
C08100869-001	137	0-5	30	36	34	CL	< 1
C08100869-002	137	5-12	20	28	52	C	< 1
C08100869-003	137	12-19	26	38	36	CL	< 1
C08100869-004	138	0-4	72	12	16	SL	< 1
C08100869-005	138	4-15	68	18	14	SL	< 1
C08100869-006	139	0-7	38	32	30	CL	< 1
C08100869-007	139	7-20	42	34	24	L	< 1
C08100869-008	139	20-36	30	38	32	CL	< 1
C08100869-009	139	36-46	12	38	50	C	< 1
C08100869-010	139	46-60	18	44	38	SiCL	< 1
C08100869-011	140	0-9	52	22	26	SCL	< 1
C08100869-012	140	9-20	70	14	16	SL	< 1
C08100869-013	140	20-35	64	22	14	SL	< 1
C08100869-014	140	35-45	18	24	58	C	< 1
C08100869-015	140	45-55	26	20	54	C	< 1
C08100869-016	140	55-60	14	16	70	C	16
C08100869-017	141	0-11	62	12	26	SCL	5
C08100869-018	141	11-21	64	14	22	SCL	4
C08100869-019	142	0-8	82	6	12	SL	< 1
C08100869-020	142	8-16	78	10	12	SL	1
C08100869-021	146	0-9	25	20	55	C	4
C08100869-022	146	9-24	19	28	53	C	16
C08100869-023	148	0-9	53	25	22	SCL	3
C08100869-024	148	9-17	51	23	26	SCL	4
C08100869-025	148	17-24	43	30	27	CL - L	5
C08100869-026	148	24-37	63	15	22	SCL	5
C08100869-027	148	37-60	53	24	23	SCL	3
C08100869-028	150	0-5	73	12	15	SL	2
C08100869-029	150	5-12	75	11	14	SL	2
C08100869-030	150	12-20	83	8	9	LS	2
C08100869-031	150	20-35	81	10	9	LS	2
C08100869-032	151	0-7	33	29	38	CL	3
C08100869-033	151	7-24	11	39	50	C	11
C08100869-034	152	0-9	53	23	24	SCL	3
C08100869-035	152	9-19	51	19	30	SCL	3
C08100869-036	152	19-39	45	24	31	CL	2
C08100869-037	152	39-55	49	23	28	SCL	1
C08100869-038	152	55-60	53	13	34	SCL	3
C08100869-039	153	0-5	67	16	17	SL	< 1
C08100869-040	153	5-16	63	20	17	SL	< 1

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	Sand	Silt	Clay	Texture	Coarse Frags
		Units	%	%	%		%
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results
C08100869-041	153	16-31	65	8	27	SCL	2
C08100869-042	153	31-46	59	11	30	SCL	4
C08100869-043	153	46-60	53	15	32	SCL	1
C08100869-044	154	0-7	49	18	33	SCL	2
C08100869-045	154	7-18	47	15	38	SC	7
C08100869-046	154	18-24	41	20	39	CL	3
C08100869-047	154	24-36	29	23	48	C	6
C08100869-048	155	0-11	48	18	34	SCL	6
C08100869-049	155	11-19	51	14	35	SCL - SC	4
C08100869-050	155	19-26	53	17	30	SCL	2
C08100869-051	155	26-37	65	8	27	SCL	3
C08100869-052	155	37-48	63	13	24	SCL	4
C08100869-053	155	48-60	71	7	22	SCL	2
C08100869-054	156	0-12	53	17	30	SCL	3
C08100869-055	156	12-29	13	27	60	C	8
C08100869-056	156	29-37	11	35	54	C	6
C08100869-057	156	37-53	33	22	45	C	6
C08100869-058	156	53-60	39	24	37	CL	3
C08100869-059	158	0-12	33	24	43	C	5
C08100869-060	158	12-25	39	25	36	CL	3
C08100869-061	158	25-33	61	19	20	SL - SCL	5
C08100869-062	158	33-48	63	15	22	SCL	2
C08100869-063	158	48-60	88	2	10	LS	1
C08100869-064	159	0-14	27	23	50	C	3
C08100869-065	159	14-28	31	27	42	C	4
C08100869-066	159	28-37	45	23	32	CL	5
C08100869-067	159	37-60	49	21	30	SCL	5
C08100869-068	160	0-13	33	33	34	CL	4
C08100869-069	160	13-21	33	27	40	C - CL	5
C08100869-070	160	21-33	39	25	36	CL	3
C08100869-071	160	33-55	25	33	42	C	4
C08100869-072	160	55-60	33	27	40	C - CL	4
C08100869-073	161	0-12	41	21	38	CL	3
C08100869-074	161	12-28	31	26	43	C	4
C08100869-075	161	28-46	27	29	44	C	6
C08100869-076	161	46-60	61	15	24	SCL	3
C08100869-077	162	0-12	29	31	40	C - CL	4
C08100869-078	163	0-7	25	35	40	C - CL	4
C08100869-079	163	7-20	23	41	36	CL	7
C08100869-080	163	20-29	22	58	20	SiL	6

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	Sand	Silt	Clay	Texture	Coarse Frags
		Units	%	%	%		%
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results
C08100869-081	163	29-37	29	41	30	CL	4
C08100869-082	163	37-50	31	39	30	CL	5
C08100869-083	163	50-60	33	33	34	CL	5
C08100869-084	164	0-10	47	25	28	SCL	2
C08100869-085	164	10-20	41	27	32	CL	3
C08100869-086	164	20-34	39	25	36	CL	8
C08100869-087	165	0-17	31	37	32	CL	4
C08100869-088	165	17-27	45	25	30	CL	4
C08100869-089	165	27-36	42	26	32	CL	3
C08100869-090	165	36-48	33	37	30	CL	8
C08100869-091	165	48-60	43	21	36	CL	< 1
C08100869-092	166	0-7	81	9	10	LS	4
C08100869-093	166	7-21	73	11	16	SL	4
C08100869-094	166	21-36	83	3	14	SL	4
C08100869-095	166	36-48	87	1	12	LS	2
C08100869-096	168	0-9	39	37	24	L	3
C08100869-097	168	9-29	51	31	18	L	3
C08100869-098	168	29-41	51	33	16	L	3
C08100869-099	168	41-51	62	18	20	SL - SCL	1
C08100869-100	168	51-60	63	19	18	SL	3
C08100869-101	170	0-9	63	3	34	SCL	4
C08100869-102	170	9-29	33	37	30	CL	3
C08100869-103	170	29-40	45	23	32	CL	4
C08100869-104	170	40-60	39	29	32	CL	4
C08100869-105	171	0-7	33	31	36	CL	5
C08100869-106	172	0-12	61	17	22	SCL	2
C08100869-107	172	12-19	71	11	18	SL	2
C08100869-108	172	19-29	81	5	14	SL	4
C08100869-109	173	0-15	65	11	24	SCL	< 1
C08100869-110	173	15-31	59	17	24	SCL	< 1
C08100869-111	173	31-37	53	27	20	SL - SCL	< 1
C08100869-112	173	37-55	69	13	18	SL	1
C08100869-113	173	55-60	39	39	22	L	5
C08100869-114	174	0-3	33	35	32	CL	3
C08100869-115	174	3-10	29	27	44	C	3
C08100869-116	174	10-20	27	27	46	C	3
C08100869-117	174	20-36	29	21	50	C	3
C08100869-118	174	36-48	27	41	32	CL	3
C08100869-119	175	0-4	92	< 1	8	S	< 1
C08100869-120	175	4-17	51	17	32	SCL	10

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	Sand	Silt	Clay	Texture	Coarse Frags
		Units	%	%	%		%
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results
C08100869-121	175	17-33	53	15	32	SCL	6
C08100869-122	175	33-41	69	11	20	SL - SCL	3
C08100869-123	175	41-48	51	15	34	SCL	11
C08100869-124	177	0-2	47	23	30	SCL	0
C08100869-125	177	2-15	41	25	34	CL	6
C08100869-126	178	0-2	69	19	12	SL	0
C08100869-127	178	2-12	71	11	18	SL	3
C08100869-128	178	12-18	63	10	18	SL	4
C08100869-129	178	18-29	73	3	24	SCL	2
C08100869-130	178	29-35	81	4	15	SL	2
C08100869-131	178	35-60	78	6	16	SL	3
C08100869-132	180	0-2	21	33	46	C	3
C08100869-133	180	2-12	37	23	40	C - CL	5
C08100869-134	180	12-19	33	29	38	CL	3
C08100869-135	180	19-37	41	23	36	CL	3
C08100869-136	181	0-2	63	13	24	SCL	1
C08100869-137	181	2-9	71	11	18	SL	3
C08100869-138	181	9-21	73	7	20	SL - SCL	3
C08100869-139	182	0-2	79	7	14	SL	< 1
C08100869-140	182	2-15	82	2	16	SL	< 1
C08100869-141	182	15-30	80	8	12	SL	< 1
C08100869-142	182	30-44	74	12	14	SL	< 1
C08100869-143	183	0-8	38	32	30	CL	0
C08100869-144	183	8-22	26	50	24	SIL - L	5
C08100869-145	184	0-8	54	26	20	SL - SCL	4
C08100869-146	184	8-17	42	28	30	CL	4
C08100869-147	185	0-2	62	24	14	SL	2
C08100869-148	185	2-19	61	17	22	SCL	2
C08100869-149	185	19-31	60	14	26	SCL	3
C08100869-150	185	31-48	70	10	20	SL - SCL	2
C08100869-151	186	0-8	28	42	30	CL	3
C08100869-152	186	8-18	48	20	32	SCL	5
C08100869-153	186	18-31	34	34	32	CL	5
C08100869-154	186	31-43	52	22	26	SCL	3
C08100869-155	186	43-60	50	20	30	SCL	3
C08100869-156	187	0-8	24	26	50	C	6
C08100869-157	187	8-17	18	30	52	C	6
C08100869-158	187	17-22	12	38	50	C	20
C08100869-159	188	0-9	62	18	20	SL - SCL	3
C08100869-160	188	9-21	72	8	20	SL - SCL	4

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
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Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	Sand	Silt	Clay	Texture	Coarse Frags
		Units	%	%	%		%
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results
C08100869-161	188	21-30	61	9	30	SCL	3
C08100869-162	188	30-49	65	7	28	SCL	5
C08100869-163	189	0-8	49	13	38	SC	5
C08100869-164	189	8-18	51	19	30	SCL	4
C08100869-165	189	18-24	33	33	34	CL	7
C08100869-166	190	0-3	69	19	12	SL	3
C08100869-167	190	3-14	61	11	28	SCL	3
C08100869-168	190	14-38	69	9	22	SCL	5
C08100869-169	190	38-40	61	17	22	SCL	2
C08100869-170	191	0-3	69	11	20	SL - SCL	1
C08100869-171	191	3-11	77	7	16	SL	3
C08100869-172	191	11-18	71	13	16	SL	1
C08100869-173	191	18-34	73	7	20	SL - SCL	6
C08100869-174	192	0-1	43	25	32	CL	6
C08100869-175	192	1-8	19	35	46	C	12
C08100869-176	193	0-3	45	25	30	CL	3
C08100869-177	193	3-10	25	31	44	C	6
C08100869-178	193	10-18	31	39	30	CL	4
C08100869-179	193	18-36	29	39	32	CL	5
C08100869-180	193	36-60	20	21	50	C	6
C08100869-181	194	0-8	38	22	40	C - CL	7
C08100869-182	194	8-17	24	42	34	CL	5
C08100869-183	194	17-32	26	38	36	CL	9
C08100869-184	194	32-44	30	30	40	C - CL	7
C08100869-185	195	0-9	74	16	10	SL	3
C08100869-186	195	9-18	72	12	16	SL	5
C08100869-187	195	18-37	74	14	12	SL	4
C08100869-188	195	37-48	73	13	14	SL	5
C08100869-189	197	0-4	64	22	14	SL	4
C08100869-190	197	4-10	70	6	24	SCL	9
C08100869-191	197	10-19	74	10	16	SL	3
C08100869-192	197	19-36	90	< 1	10	LS	2
C08100869-193	197	36-48	92	2	6	S	2
C08100869-194	198	0-6	66	20	14	SL	3
C08100869-195	198	6-22	54	26	20	SL - SCL	2
C08100869-196	199	0-3	52	26	22	SCL	4
C08100869-197	199	3-14	58	26	16	SL	4
C08100869-198	199	14-26	54	18	28	SCL	3
C08100869-199	199	26-43	56	14	30	SCL	2
C08100869-200	199	43-60	52	26	22	SCL	3

LABORATORY ANALYTICAL REPORT

Client: Uranium One Americas
Project: 539A Ludeman Uranium
Workorder: C08100869

Report Date: 12/17/08
Date Received: 10/17/08

		Analysis	Sand	Silt	Clay	Texture	Coarse Frags
		Units	%	%	%		%
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results
C08100869-201	201	0-2	60	20	20	SL - SCL	6
C08100869-202	201	2-10	62	< 1	38	SC	8
C08100869-203	201	10-31	40	26	34	CL	4
C08100869-204	201	31-42	44	26	30	CL	4
C08100869-205	201	42-48	46	22	32	SCL	4
C08100869-206	202	0-4	20	36	44	C	1
C08100869-207	202	4-17	14	42	44	SiC	12
C08100869-208	202	17-27	46	30	24	L	6
C08100869-209	202	27-36	48	26	26	SCL	9
C08100869-210	202	36-48	62	18	20	SL - SCL	3
C08100869-211	203	0-2	40	22	38	CL	4
C08100869-212	203	2-8	46	18	36	SC	6
C08100869-213	203	8-21	30	26	44	C	4
C08100869-214	203	21-40	28	46	26	L	9
C08100869-215	204	0-9	54	24	22	SCL	5
C08100869-216	204	9-22	60	20	20	SL - SCL	10
C08100869-217	204	22-29	62	14	24	SCL	3
C08100869-218	204	29-48	88	< 1	12	LS	< 1

ADDENDUM 3.3-F
PRIME FARMLAND DESIGNATION

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
1954 E. Richards, #10
Douglas, Wyoming 82633

November 24, 2008

Adam Beilke
BKS Environmental Associates Inc.
P.O. Box 3467
Gillette, WY 82717

Adam,

No prime farmland exists on the previously identified legal descriptions you provided for the proposed uranium mine area north of Glenrock. The enclosed maps and descriptions are that verification.

Tim

Tim Schroeder
District Conservationist
Douglas NRCS

Helping People Help the Land

An Equal Opportunity Provider and Employer

Farmland Classification

Aggregation Method: No Aggregation Necessary
Tie-break Rule: Lower

Converse County, Wyoming, Southern Part
Survey Area Version and Date: 6 - 09/15/2008

Map symbol	Map unit name	Rating
122	Clarkelen fine sandy loam, overflow, 0 to 3 percent slopes	Not prime farmland
123	Clarkelen fine sandy loam, wet, 0 to 3 percent slopes	Not prime farmland
125	Clarkelen, wet-Haverdad, wet-Bigwinder complex, 0 to 3 percent slopes	Not prime farmland
127	Clarkelen-Draknab complex, wet, 0 to 3 percent slopes	Not prime farmland
128	Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes	Not prime farmland
129	Clarkelen-Haverdad-Bigwinder complex, 0 to 3 percent slopes	Not prime farmland
138	Draknab loamy fine sand, wet, 0 to 3 percent slopes	Not prime farmland
140	Dune land-Orpha complex, 10 to 30 percent slopes	Not prime farmland
141	Dwyer-Orpha loamy sands, 3 to 15 percent slopes	Not prime farmland
152	Forkwood-Cambria loams, 0 to 6 percent slopes	Not prime farmland
154	Forkwood-Cambria-Cushman loams, 6 to 15 percent slopes	Not prime farmland
155	Forkwood-Ulm complex, 0 to 6 percent slopes	Not prime farmland
158	Gravel pits and quarries	Not prime farmland
164	Haverdad loam, wet, 0 to 3 percent slopes	Not prime farmland
166	Haverdad-Clarkelen complex, lowlands, 0 to 3 percent slopes, rarely flooded	Not prime farmland
167	Haverdad-Clarkelen complex, wet, 0 to 3 percent slopes	Not prime farmland
171	Hiland-Bowbac sandy loams, 0 to 6 percent slopes	Not prime farmland
172	Hiland-Bowbac fine sandy loams, 0 to 6 percent slopes	Not prime farmland
173	Hiland-Bowbac fine sandy loams, 6 to 15 percent slopes	Not prime farmland
175	Hiland-Bowbac complex, 6 to 15 percent slopes	Not prime farmland
178	Keeline fine sandy loam, 0 to 6 percent slopes	Not prime farmland
182	Keeline-Kishona complex, 0 to 6 percent slopes	Not prime farmland
183	Keeline-Kishona-Theedle complex, 6 to 30 percent slopes	Not prime farmland
184	Keeline-Turnercrest fine sandy loams, 3 to 10 percent slopes	Not prime farmland
186	Keyner-Absted-Slickspots complex, 0 to 6 percent slopes	Not prime farmland
187	Kishona-Cambria loams, 0 to 6 percent slopes	Not prime farmland
189	Kishona-Cambria-Theedle loams, 3 to 20 percent slopes	Not prime farmland
225	Samday-Shingle-Worf complex, 3 to 15 percent slopes	Not prime farmland
226	Samday-Shingle-Worf, loamy complex, 3 to 15 percent slopes	Not prime farmland
230	Shingle-Badland-Samday complex, 10 to 30 percent slopes	Not prime farmland
233	Shingle-Taluce-Badland complex, 10 to 40 percent slopes	Not prime farmland
237	Sunup-Threetop-Rock outcrop complex, 10 to 40 percent slopes	Not prime farmland
238	Taluce-Badland-Turnercrest complex, 6 to 50 percent slopes	Not prime farmland
239	Taluce-Shingle complex, 6 to 30 percent slopes	Not prime farmland
243	Taluce-Tullock-Vonalee association, 6 to 30 percent slopes	Not prime farmland
244	Taluce-Turnercrest-Keeline fine sandy loams, 3 to 20 percent slopes	Not prime farmland
245	Tassel-Shingle complex, 2 to 30 percent slopes	Not prime farmland
246	Tassel-Tullock-Vonalee association, 6 to 30 percent slopes	Not prime farmland
250	Theedle-Kishona loams, 6 to 15 percent slopes	Not prime farmland
251	Theedle-Kishona-Shingle loams, 3 to 30 percent slopes	Not prime farmland
255	Ulm loam, 0 to 6 percent slopes	Not prime farmland
257	Ulm-Bidman complex, 0 to 6 percent slopes	Not prime farmland
258	Ulm-Forkwood loams, 0 to 6 percent slopes	Not prime farmland
259	Ulm-Renohill clay loams, 0 to 6 percent slopes	Not prime farmland
260	Ulm-Renohill clay loams, 6 to 15 percent slopes	Not prime farmland
263	Ustic Torriorthents, gullied, 3 to 45 percent slopes	Not prime farmland
264	Vonalee fine sandy loam, 0 to 6 percent slopes	Not prime farmland

USDA Natural Resources Conservation Service

Application Version: 5.0.002.0008

11/14/2008

Page 1 of 3

Farmland Classification

Aggregation Method: No Aggregation Necessary
Tie-break Rule: Lower

Converse County, Wyoming, Southern Part
Survey Area Version and Date: 6 - 09/15/2008

Map symbol	Map unit name	Rating
265	Vonalee-Terro fine sandy loams, 0 to 6 percent slopes	Not prime farmland
266	Vonalee-Terro fine sandy loams, 6 to 15 percent slopes	Not prime farmland
267	Water	Not prime farmland
269	Worf-Shingle-Taluce complex, 3 to 30 percent slopes	Not prime farmland
270	Worf-Shingle-Tassel complex, 3 to 30 percent slopes	Not prime farmland

Farmland Classification

Rating Options

Attribute Name: Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Aggregation Method: No Aggregation Necessary

Aggregation is the process by which a set of component attribute values is reduced to a single value to represent the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. The components in the map unit name represent the major soils within a map unit delineation. Minor components make up the balance of the map unit. Great differences in soil properties can occur between map unit components and within short distances. Minor components may be very different from the major components. Such differences could significantly affect use and management of the map unit. Minor components may or may not be documented in the database. The results of aggregation do not reflect the presence or absence of limitations of the components which are not listed in the database. An on-site investigation is required to identify the location of individual map unit components.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be generated. Aggregation must be done because, on any soil map, map units are delineated but components are not.The majority of soil attributes are associated with a component of a map unit, and such an attribute has to be aggregated to the map unit level before a thematic map can be rendered. Map units, however, also have their own attributes. An attribute of a map unit does not have to be aggregated in order to render a corresponding thematic map. Therefore, the "aggregation method" for any attribute of a map unit is referred to as "No Aggregation Necessary"

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

ADDENDUM 3.3-G
PROFESSIONAL CERTIFICATIONS

ARCPACS

A Federation of Certifying Boards in Agriculture, Biology, Earth and Environmental Sciences

Certifies that

Brenda K. Schladweiler, BS

Subscribes to the Code of Ethics and has met the requirements established for the certification of

as a

Certified Professional Soil Scientist

Certification effective from:
1/1/2009 to 12/31/2010
Number: 15269

SSSA President

Soils Certifying Board Chair

ARCPACS is a membership service of the American Society of Agronomy