InterTech

August, 2014

Site Specific Reclamation Amendment Recommendations Report

Prepared For:

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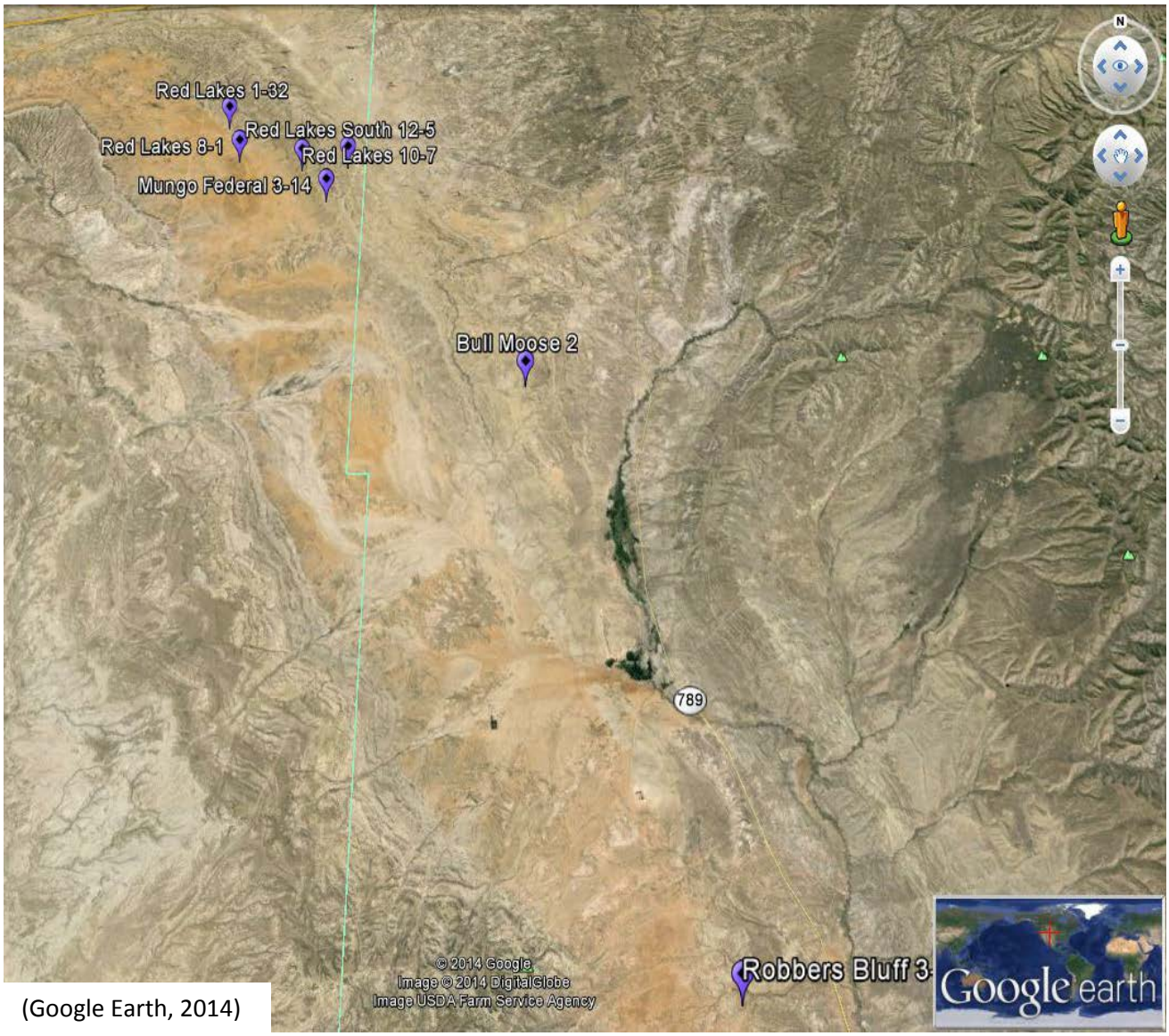
InterTech

TABLE OF CONTENTS

Introduction

On June 26, 2014 (06/26/14) InterTech Environmental and Engineering Environmental (ITEE) Scientist, J. Faulkner and QEP Energy Company (QEP) Reclamation Specialist, P. Guernsey traveled to the Wamsutter gas field area in southeastern Wyoming (WY). The purpose of the visit was to collect field observations and soil samples from seven (7) well-pad sites, for use in preparing amendment recommendations for final reclamation processes at these locations.

Sites visited included Red Lakes 1-32; Red Lakes 8-1; Red Lakes 10-7; Mungo Federal 3-14; Red Lakes South 12-5; Bull Moose 2; and Robber's Bluff 3-3 (See map below)(Google Earth, 2014). Each site had multiple subsamples collected for an overall composite sample, and Red Lakes 1-32 had an additional composite sample collected from its topsoil pile. Soils were sent to InterMountain Labs (IML) in Sheridan, WY for analyses.



(Google Earth, 2014)

A combination of agency guidelines, lab results, field observations, Natural Resources Conservation Services (NRCS) data and mapping, expert collaboration, and literature review were utilized to provide the enclosed amendment recommendations to promote native plant species growth on the reclaimed sites. Overall site comparisons are given based on agency guidelines for reclaimed topsoil quality. Each site is then given independent consideration for amendment recommendations based on comprehensive data and research.

Background

The general area of the sites sampled is in an arid, high elevation (6-7,000 feet), calcareous region in southeast WY. Average annual rainfall for the area is 6-12 inches. Soils here formed from "sandstones in the Cretaceous Lewis and Mesaverde formations" (Lageson and Spearing , 1998). This area has high wind speeds and large amounts of soils have been distributed by wind deposition. Soil textures in the area vary, and are an important property when considering a site's reclamation potential. Sandy, silty, or clayey soils are not as ideal plant growth mediums, as are loamy soils. Too much sand leads to rapid drying, and poor nutrient retention and water holding capacity. Silty soils are prone to erosion, and high clay content can cause slow infiltration, run-off, crusting, and cementing in soils.

Weathering of limestone ($CaCO_3$), dolomite ($CaMg(CO_3)_2$),and gypsum ($CaSO4{\cdot}2H2O$), in WY soils, leads to high carbonate (CO_3^{-2}) levels and, usually to a lesser degree, sulfate (SO_4^-) levels. High calcium carbonate levels can decrease water infiltration abilities, causing crusting and hardening of soils with high clay content, and can also decrease the availability of phosphorous, a primary plant nutrient (Norton, 2012).

Salts are soluble combinations of cations such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), or potassium (K^+), and an associated anion such as CO_3^{2-}, SO_4^-, or chloride (Cl^-). Dry WY soils experience accumulation of salts containing predominantly the cations Ca^{2+} and Mg^{2+}. Salts precipitate and move upward through the soil profile with evaporation, in contrast to areas receiving higher precipitation resulting in salts being leached through the profile. High salt levels can create a saline soil environment. Minimally to moderate saline soils typically have good fertility, but higher levels of salts can be toxic to plants or the animals that consume them. Selenium accumulation can occur in WY rangeland plants at levels toxic to livestock and wildlife (Raisbeck et al.). Additionally water uptake by plants can be hindered by excessively high salt levels as indicated by a high electrical conductivity (EC) reading (Norton and Strom, 2012).

High sodium levels can also be problematic in WY soils, as sodium causes soil dispersion which destroys soil structure and hinders water infiltration. Sodic soils have high pH values, which hinders native plant species' growth as many micronutrients become unavailable to plants at pH values above 8.5.

Wyoming Agency Guidelines and Topsoil Quality Parameters

Guidelines from WY Bureau of Land Management (BLM) and WY Department of Environmental Quality (WYDEQ) are presented below as a reference for practitioners in determining appropriate parameters for topsoil quality in WY reclamation settings. The following excerpts are from the WYBLM and WYDEQ publications, respectively:

Topsoil: A suitable soil usually has characteristics that do not inhibit plant growth, but rather will enhance plant growth. Suitable soil usually has a moderate pH (usually above 6.0 and below 8.4), has a salt content represented by an electrical conductivity (EC) less than 8 dS/m, sodium adsorption ratio (SAR) less than 13, and a loamy (not sandy, silty, or clayey) texture (BLM, 2011).

Table I-2: Criteria to establish suitability of topsoil (or topsoil substitutes).

Parameter	Suitable	Marginal 1/	Unsuitable
pH	5.5-8.5	5.0-5.5 8.5-9.0	<5.0 >9.0
EC (Conductivity) mmhos/cm	0-8	8-12	>12
Saturation Percentage	25-80	<25 >80	
Texture		c,sic,s	
SAR 2/	0-10	10-12 3/ 10-15	>12 3/ >15
Selenium	*<0.3 ppm*	*>0.3-0.8 ppm 4/*	*5/*
Boron	<5.0 ppm		>5.0 ppm
Coarse Frag (% vol)	<25%	25-35	>35%

1/ Evaluated on an individual basis for suitability.

2/ As an alternative to SAR calculations, ESP (exchangeable sodium percentage) can be determined. ESP should be determined if suitable SAR value is exceeded.

3/ For fine textured soils (clay >40%)

4/ *These marginally suitable values are keyed to sampling vegetation at bond release. Vegetation >5 ppm Se is considered unsuitable.*

5/ *No specific limit of extractable selenium concentration is provided because of the lack of data for spoil material > 0.8 ppm.*

(WYDEQ, 1994)

Site Specific Data and Recommendations

Considering only WY BLM and DEQ criteria, sites showing reduced reclamation potential include all but Red Lakes 10-7, as highlighted in the table below. Red Lakes 8-1 has elevated pH and SAR levels, and over ≥40% clay and Red Lakes 12-5 has saline-sodic soils giving these sites the lowest reclamation potential and candidates for more intensive amendment recommendations. Saturation percent and cation exchange capacity (CEC) are recommended for inclusion in future soil sampling events to help assess agency objectives and to better help determine soil reclamation potential.

QEP Reclamation Sites	BLM/DEQ Parmeters			DEQ Parameters Only			
Sample ID	*pH*	*EC (dS/m)*	*SAR*	*Texture*	*Coarse Frag. (%)*	*Se (ppm)*	*B (ppm)*
Red_Lakes_8_1_Reclaimed	8.5	2.55	29.3	silty clay	0.2	0.02	1.57
Red_Lakes_South_12_5_Reclaimed	8.2	7.21	24.8	sandy clay loam	0.8	<0.02	0.40
Robbers_Bluff_3_3_Reclaimed	8.1	4.61	1.73	clay	1.8	<0.02	0.35
Bull_Moose_2_Reclaimed	7.9	0.80	2.39	sandy clay	1.0	<0.02	0.62
Red_Lakes_1_32_Reclaimed	7.6	1.43	0.40	clay	1.8	<0.02	0.59
Red_Lakes_1_32_Topsoil	8.0	0.72	3.30	clay	0.7	<0.02	0.66
Mungo_Federal_3_14_Reclaimed	8.1	1.81	9.22	silty clay	0.3	0.02	1.11
Red_Lakes_10_7_Reclaimed	7.9	2.48	6.20	sandy loam	0.2	<0.02	0.59
Outside Suitable Topsoil Criteria =		All lab data except texture provided by IML- Sheridan, WY					

The Robber's Bluff 3-3 site has slightly saline soil but no sodicity issues. The Red Lakes 8-1 site has sodic soil, but no salinity issues. In contrast, the Red Lakes South 12-5 site has moderately elevated EC levels, combined with elevated pH, and high Sodium Adsorption Ratios (SAR) levels, making reclamation of this site with saline-sodic soils especially challenging.

Gypsum is a typically suggested amendment for soils with sodicity problems. With enough water, the calcium from gypsum replaces sodium on clay surfaces and flocculates soil particles promoting aggregation and infiltration. Even if salinity or sodicity is not an issue, arid conditions are the most limiting factor in reclamation of drastically disturbed areas in WY. For this reason, it is recommended that every site have surface roughening and or/imprinting done to help capture natural precipitation and promote micro-climates, as part of their reclamation process. Addition of water to reclamation sites is often not a practical or economically viable option for remote areas in WY. Several of the sites visited had soils lab results showing high levels of calcium and sulfate already present, suggesting native presence of gypsum in the soil. High limestone and gypsum soils have increased pH buffering capacity, meaning these soils are not highly sensitive to acidic additions, as free hydrogen ions introduced to the soil are quickly neutralized by the anions of limestone and gypsum (McCauley et al., 2005). Because large amounts of gypsum and water are required for this amendment to be effective, especially for pH buffered soils, amendment recommendations intended to increase overall soil organic matter (SOM), which can dilute salts and sodium and have other beneficial results including capturing and retention of

moisture, are also or alternatively suggested for reducing high pH and sodic soils. Organic matter additions should also be considered for sites with less than 0.89% OM, which is the historically accepted minimum level needed to maintain nutrient cycling in reclaimed soils. Soils already high in calcium carbonate may respond to dissolution by sulfuric acid or elemental sulfur, which also allow calcium ions to replace sodium ions on soil surfaces.

It is also recommended that saline and sodic sites be disced to improve drainage potential followed by reseeding with salt-tolerant plant native plant species. Ecological Site Description (ESD) vegetation lists associated with each site are provided (Appendix I) as a reference for native species found in these areas. The following table (adapted from Norton and Strom, 2012) provides an additional general list of plants with varying levels of salt tolerance:

Salt Tolerant Plant Species

Common name	Scientific name	Tolerance level
Black greasewood	Sarcobatus vermiculatus	Very high
Nuttall's alkaligrass	Puccinellia nuttalliana	20-30 dS/m
Inland saltgrass	Distichlis stricta	
Beardless wildrye	Leymus triticoides	
Shore arrowgrass	Triglochin maritime	
Alkali cordgrass	Spartina gracilis Elymus	
Slender wheatgrass	trachycaulus Atriplex spp	High
Saltbush species	Krascheninnikovia lanata	16-19 dS/m
Winterfat	Poa juncifolia	
Alkali bluegrass	Sporobolus airoides	
Alkali sacaton	Horedeum jubatum	
Plains bluegrass	Poa arida	
Western wheatgrass	Pascopyrum smithii	Moderate
Thickspike wheatgrass	Elymus lanceolatus	10-15 dS/m
Gardner's saltbush	Atrillplex gardneri	
Fourwing saltbush	Atriplex canescens	

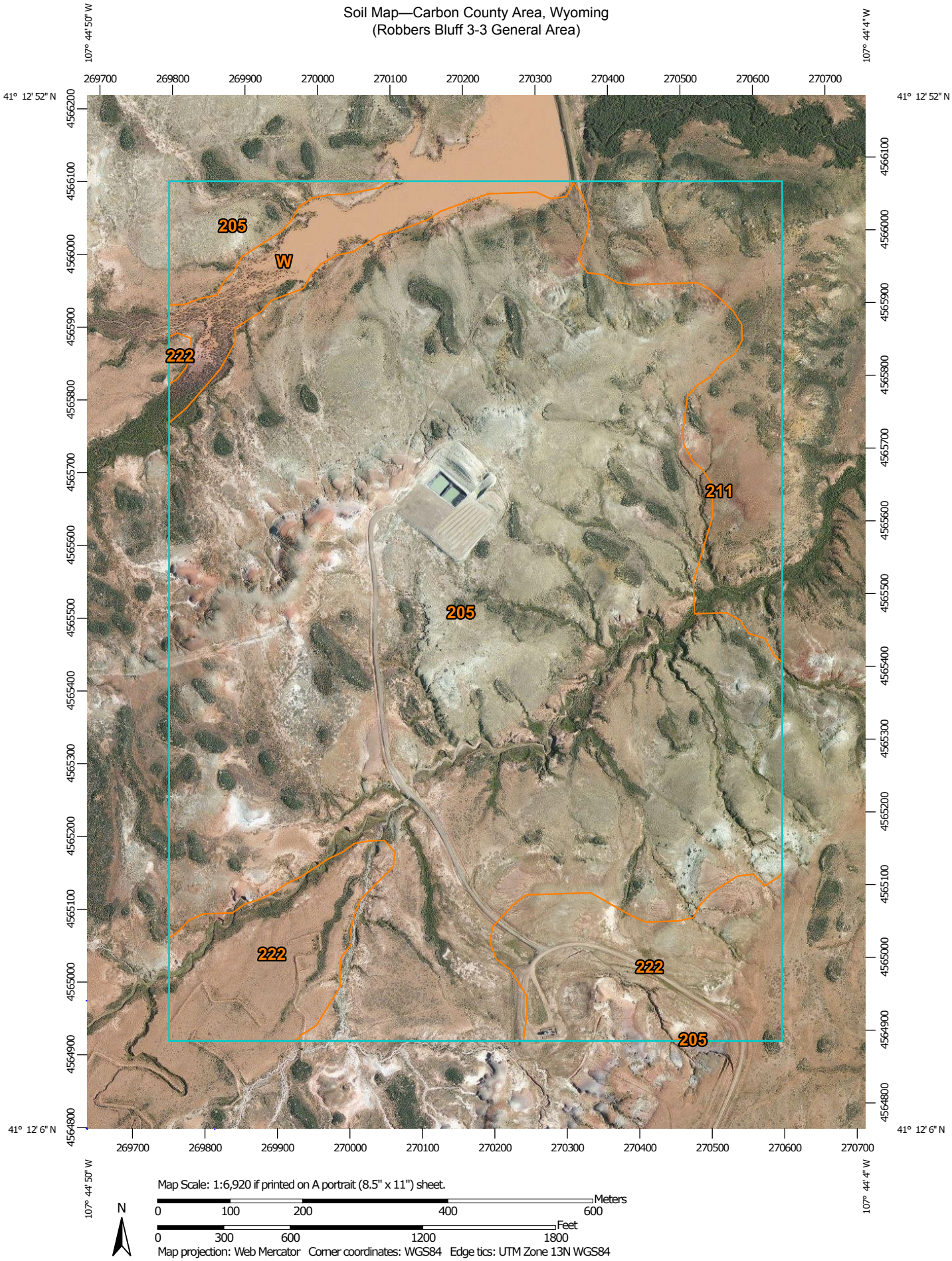
TN Plant Materials NO. 9A USDA-Natural Resources Conservation Service October 2009

Although a site may have soil characteristics within acceptable parameters as established by the WY BLM and DEQ for suitable topsoil, additional attributes and lab results of a site are still noted as worthy of consideration for the site's overall reclamation potential. Each site's general area and site specific soils map, map unit description, and site specific amendment recommendations are outlined below. Lab values shaded in grey are notably higher or lower than normal, or relative to the other sites.

Robber's Bluff 3-3

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Carbon County Area, Wyoming
(Robbers Bluff 3-3 General Area)



Map Scale: 1:6,920 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon County Area, Wyoming
Survey Area Data: Version 10, Jan 6, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Carbon County Area, Wyoming
(Robber Bluff 3-3 Soils Map)

Carbon County Area, Wyoming

Map Unit: 205—Sagecreek alkali-Sagecreek loams, 0 to 10 percent slopes

Component: Sagecreek, sodic (50%)

The Sagecreek, sodic component makes up 50 percent of the map unit. Slopes are 0 to 6 percent. This component is on heads-of-outwash, plateaus. The parent material consists of fine-loamy alluvium derived from sedimentary rock over fine-loamy alluvium derived from sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY144WY Saline Upland (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6c. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Sagecreek (30%)

The Sagecreek component makes up 30 percent of the map unit. Slopes are 0 to 6 percent. This component is on drainageways, plateaus. The parent material consists of fine-loamy alluvium derived from sedimentary rock over fine-loamy alluvium derived from sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY122WY Loamy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6c. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Carbon County Area, Wyoming

205—Sagecreek alkali-Sagecreek loams, 0 to 10 percent slopes

Map Unit Setting

- *Elevation:* 6,400 to 7,200 feet
- *Mean annual precipitation:* 7 to 12 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 65 to 105 days

Map Unit Composition

- *Sagecreek, sodic, and similar soils:* 50 percent
- *Sagecreek and similar soils:* 30 percent

Description of Sagecreek, Sodic

Setting

- *Landform:* Heads-of-outwash
- *Landform position (two-dimensional):* Toeslope
- *Landform position (three-dimensional):* Flat
- *Down-slope shape:* Concave
- *Across-slope shape:* Linear
- *Parent material:* Fine-loamy alluvium derived from sedimentary rock over fine-loamy alluvium derived from sedimentary rock

Typical profile

- *A - 0 to 6 inches:* fine sandy loam
- *Bk - 6 to 13 inches:* sandy clay loam
- *2Bk - 13 to 29 inches:* sandy clay loam
- *2By - 29 to 52 inches:* sandy clay loam
- *3C - 52 to 60 inches:* gravelly sandy loam

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.60 to 2.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 10 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Moderate (about 8.2 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 4e
- *Land capability classification (nonirrigated):* 6c
- *Hydrologic Soil Group:* B
- *Ecological site:* Saline Upland (Green River - Great Divide Basins) (R034AY144WY)

Description of Sagecreek

Setting

- *Landform:* Drainageways
- *Landform position (two-dimensional):* Toeslope
- *Landform position (three-dimensional):* Flat
- *Down-slope shape:* Concave
- *Across-slope shape:* Linear

- *Parent material:* Fine-loamy alluvium derived from sedimentary rock over fine-loamy alluvium derived from sedimentary rock

Typical profile

- *A - 0 to 8 inches:* sandy loam
- *Bt - 8 to 17 inches:* sandy loam
- *Bk - 17 to 46 inches:* sandy loam
- *C - 46 to 60 inches:* gravelly sandy loam

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 1 percent
- *Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Moderate (about 7.5 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 4e
- *Land capability classification (nonirrigated):* 6c
- *Hydrologic Soil Group:* B
- *Ecological site:* Loamy (Green River - Great Divide Basins) (R034AY122WY)

Robbers Bluff 3-3 Site Visit

06/26/14 15:16

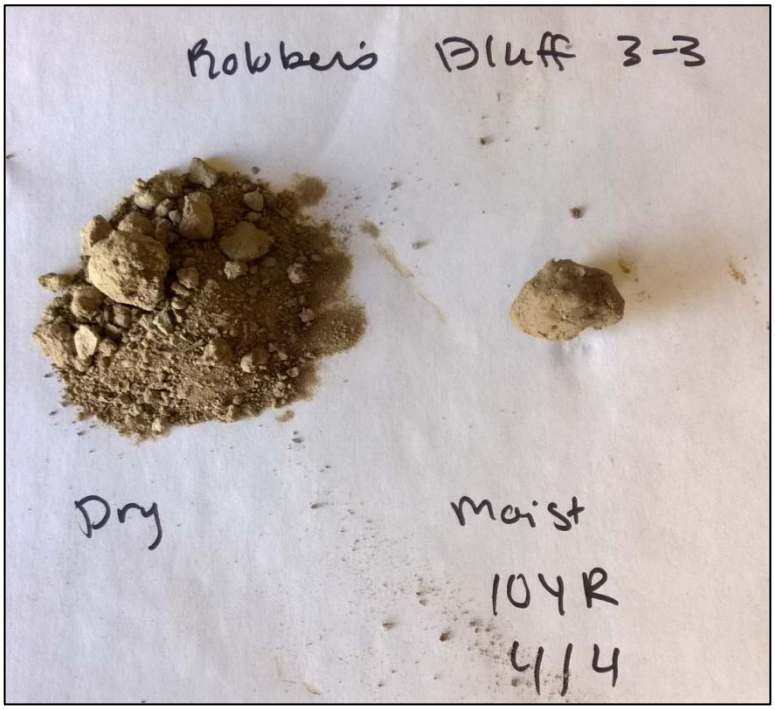
- P. Guernsey informed J. Faulkner that this site had never been fully developed. A lined pit is on site, but no other infrastructure remains. Seeded topsoil rows line the southern end of the site.
- 8 subsamples were collected at 0-6 inches from seeded topsoil rows and mixed for one composite sample

Robber's Bluff Disturbed Area

Robber's Bluff 3-3 Topsoil Rows

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed		**Native**	
Symbol	*Common Name*	*Symbol*	*Common Name*
SIHY	bottlebrush squirreltail	ATGA	Gardner's saltbush
AGSM	western wheatgrass	ORHY	indian ricegrass
ORHY	indian ricegrass	KRLA	winterfat
CHVI	douglas rabbitbrush	POSA	Sandberg bluegrass
CHVA	goosefoot	AGDA	thickspike wheatgrass
ATCA	saltbush	AGSM	western wheatgrass
BRTE	cheatgrass	GUSA	broom snakeweed
AGDA	thickspike wheatgrass	CHVI	douglas rabbitbrush
MACA	tansyaster	ERIOG	buckwheat
KRLA	winterfat	BRTE	cheatgrass
ATGA	Gardner's saltbush	ATCO	schadscale saltbush
ASTRA	milkvetch	OPPO	pricklypear
HAGL	halogeton	ARTR	Wyoming big sagebrush
		ARPE	birdfoot sagebrush



- Soil sample hand- textured on site = clay
- Munsell moist color= 10YR 4/4

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
8.1	4.61	0.4	1.73	1.8
Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
24.3	10.0	7.15	3800	8.0
Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.35	24.8	7.4	214

Amendment Recommendations:

The NRCS soils mapping data for Robber's Bluff 3-3 shows many discrepancies between the actual field data, but the maps do reveal the alkaline nature of the general area, evidenced by the white patches surrounding this site. Regardless, this site does not have severe salt or sodicity problems.

Soils at this site show slightly saline (high EC), low organic matter (OM), and elevated carbonate (CO_3^-) levels. Sulfate and calcium levels are also elevated, suggesting presence of gypsum as natural parent material or weathering by-product. Although the phosphorous levels seen here are not extremely low (Self, 2010), plant

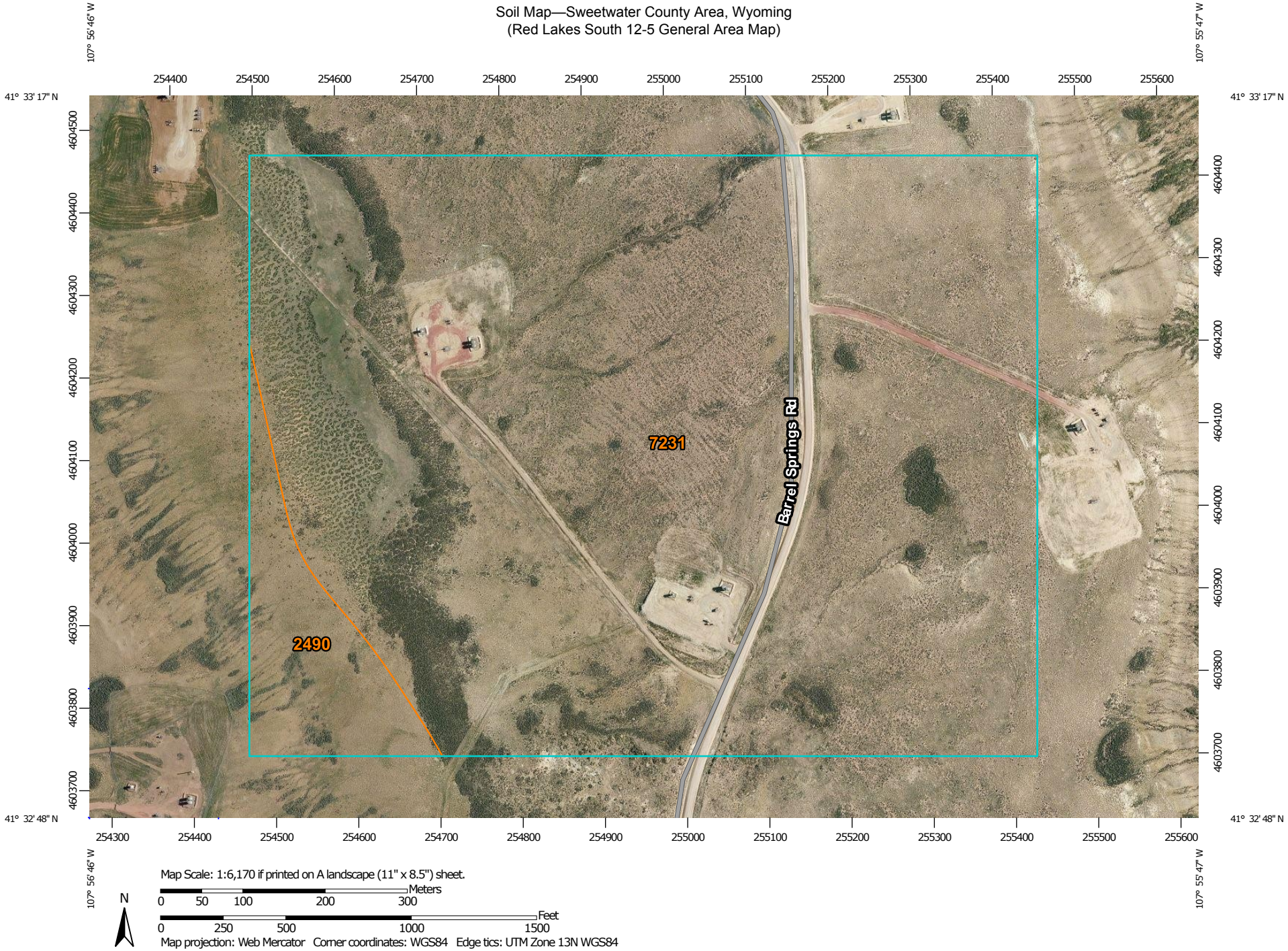
uptake of this nutrient could be limited at these levels. It is also important to consider that phosphorous has low solubility and is made less available by high calcium carbonate levels. The clay texture is also a consideration for reasons outlined in the introduction.

Suggested amendments include incorporation of an organic amendment. With the goal of reaching a minimum SOM level of 0.89%, this amount is subtracted by an existing level of 0.4%. The desired increase in SOM is by 0.49% in the top three (3) inches of soil. Assuming 3 inches of topsoil weighs 500 tons, the amount of SOM needed to achieve this goal is 2.45 tons/acre. Considering the location of this site, practical sources of OM are compost, composted cattle manure, hay, or straw. The amount of OM in the chosen amendment must be known and multiplied by the application rate to achieve the suggested amount of added OM. Because of windy and harsh weather conditions in the area, and shallow soil profiles, it is recommended that organic amendments be incorporated or disced into the topsoil.

Red Lakes 12-5

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes South 12-5 General Area Map)



MAP LEGEND

Area of Interest (AOI)
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Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

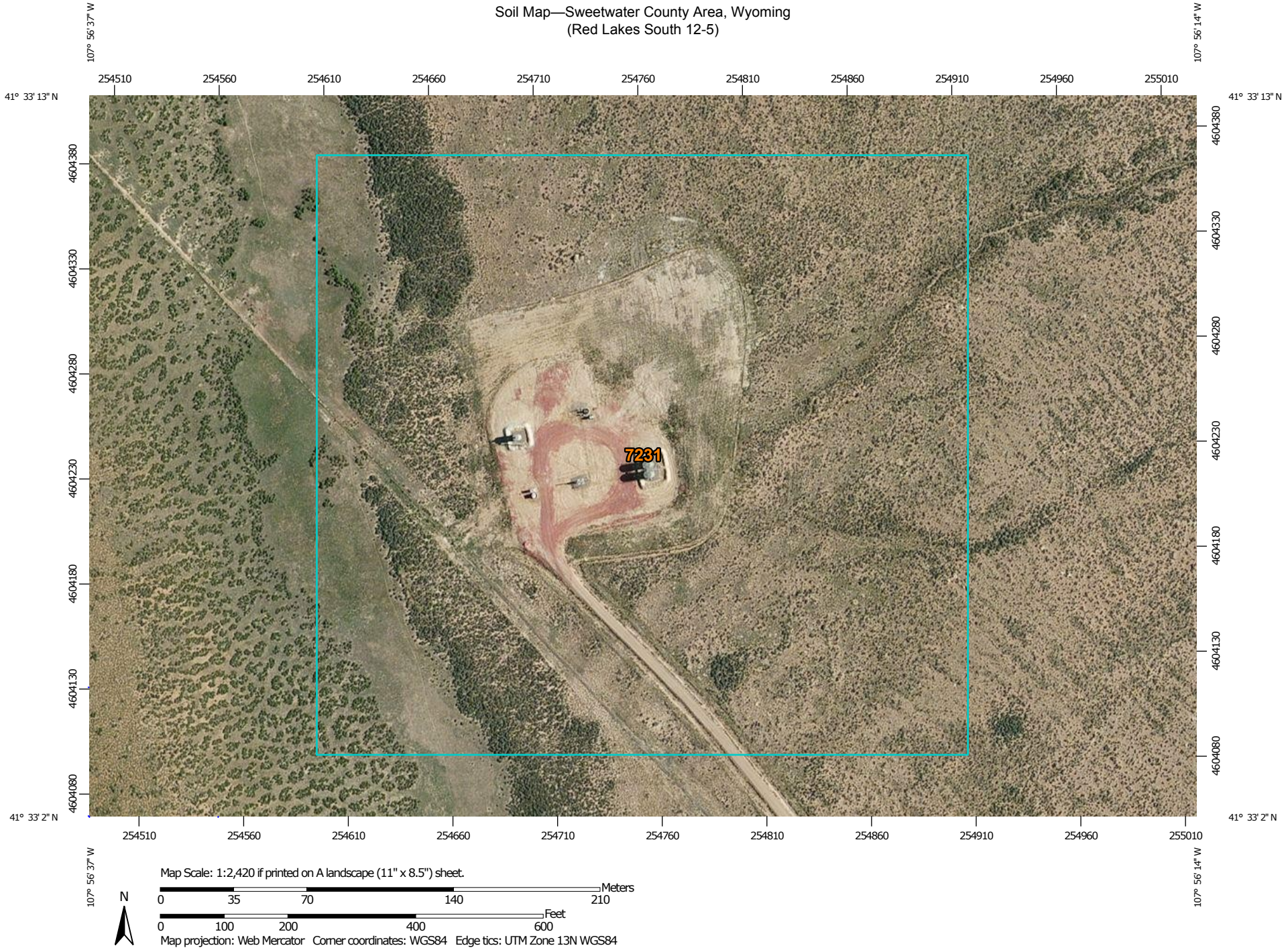
Soil Survey Area: Sweetwater County Area, Wyoming
Survey Area Data: Version 2, Jan 3, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes South 12-5)



Sweetwater County Area, Wyoming

Map Unit: 7231—Terada-Pepal complex, 1 to 15 percent slopes

Component: Terada (70%)

The Terada component makes up 70 percent of the map unit. Slopes are 0 to 15 percent. This component is on hills, ridges, intermontane basins. The parent material consists of residuum weathered from sedimentary rock. Depth to a root restrictive layer, bedrock, paralithic, is 28 to 31 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY150WY Sandy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Component: Teagulf, sodic (20%)

The Teagulf, sodic component makes up 20 percent of the map unit. Slopes are 0 to 15 percent. This component is on hills, ridges, intermontane basins. The parent material consists of residuum weathered from sedimentary rock. Depth to a root restrictive layer, bedrock, paralithic, is 33 to 37 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 6e. Irrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 20 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Sweetwater County Area, Wyoming

7231—Terada-Pepal complex, 1 to 15 percent slopes

Map Unit Setting

- *Elevation:* 6,200 to 7,200 feet
- *Mean annual precipitation:* 7 to 10 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 75 to 105 days

Map Unit Composition

- *Terada and similar soils:* 70 percent
- *Teagulf, sodic, and similar soils:* 20 percent

Description of Terada

Setting

- *Landform:* Hills, ridges

- *Landform position (two-dimensional):* Backslope
- *Landform position (three-dimensional):* Side slope
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Residuum weathered from sedimentary rock

Typical profile

- *A - 0 to 3 inches:* fine sandy loam
- *C - 3 to 29 inches:* sandy loam
- *Cr - 29 to 79 inches:* bedrock

Properties and qualities

- *Slope:* 0 to 15 percent
- *Depth to restrictive feature:* 28 to 31 inches to paralithic bedrock
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high (0.20 to 0.60 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 5 percent
- *Gypsum, maximum in profile:* 2 percent
- *Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 5.0
- *Available water storage in profile:* Low (about 3.2 inches)

Interpretive groups

- *Land capability classification (irrigated):* 4e
- *Land capability classification (nonirrigated):* 6e
- *Hydrologic Soil Group:* B
- *Ecological site:* Sandy (Green River - Great Divide Basins) (R034AY150WY)

Description of Teagulf, Sodic

Setting

- *Landform:* Hills, ridges
- *Landform position (two-dimensional):* Backslope
- *Landform position (three-dimensional):* Side slope
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Residuum weathered from sedimentary rock

Typical profile

- *A - 0 to 3 inches:* gravelly fine sandy loam
- *Bk1 - 3 to 10 inches:* gravelly fine sandy loam
- *Bk2 - 10 to 35 inches:* gravelly fine sandy loam
- *Cr - 35 to 79 inches:* bedrock

Properties and qualities

- *Slope:* 0 to 15 percent
- *Depth to restrictive feature:* 33 to 37 inches to paralithic bedrock
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high (0.20 to 0.60 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 25 percent
- *Gypsum, maximum in profile:* 2 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 5.0
- *Available water storage in profile:* Low (about 3.6 inches)

Interpretive groups

- *Land capability classification (irrigated):* 6e
- *Land capability classification (nonirrigated):* 6e
- *Hydrologic Soil Group:* B

Red Lakes 12-5 Site Visit

06/26/14 13:06

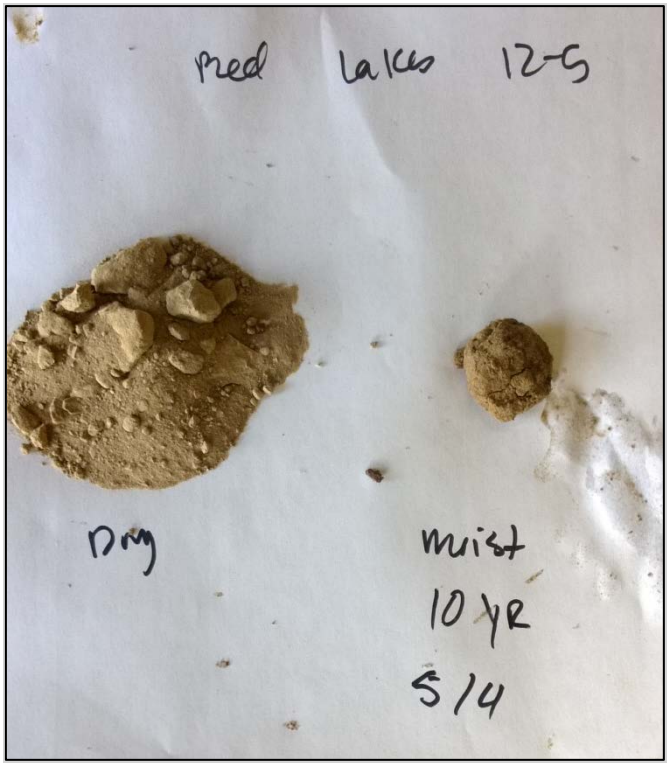
- 8 subsamples were collected at 0-6 inches from topsoil rows and mixed for one composite sample
- Visible surface salts- see photos

Red Lakes 12-5

Red Lakes 12-5

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed		**Native**	
Symbol	*Common Name*	*Symbol*	*Common Name*
SIHY	bottlebrush squirreltail	ATGA	Gardner's saltbush
AGSM	western wheatgrass	ORHY	indian ricegrass
ORHY	indian ricegrass	KRLA	winterfat
CHVI	douglas rabbitbrush	POSA	Sandberg bluegrass
AGDA	thickspike wheatgrass	AGDA	thickspike wheatgrass
ATGA	Gardner's saltbush	CHVI	douglas rabbitbrush
HAGL	halogeton	ERIOG	buckwheat
GUSA	broom snakeweed	ATCO	schadscale saltbush
HOJU	foxtail barley	OPPO	pricklypear
PSSP	bluebunch wheatgrass	ARTR	Wyoming big sagebrush
STCO	needle and threadgrass	STCO	needle and thread
		SIHY	bottlebrush squirreltail
		AGDA	thickspike wheatgrass
		PICRO	bud sagebrush



- Soil sample hand- textured on site = sandy clay loam
- Munsell moist color= 10YR 5/4

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
8.2	7.21	1.1	24.8	0.8
Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
22.4	18.6	112	5890	7.4
Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.40	32.0	9.4	179

Amendment Recommendations:

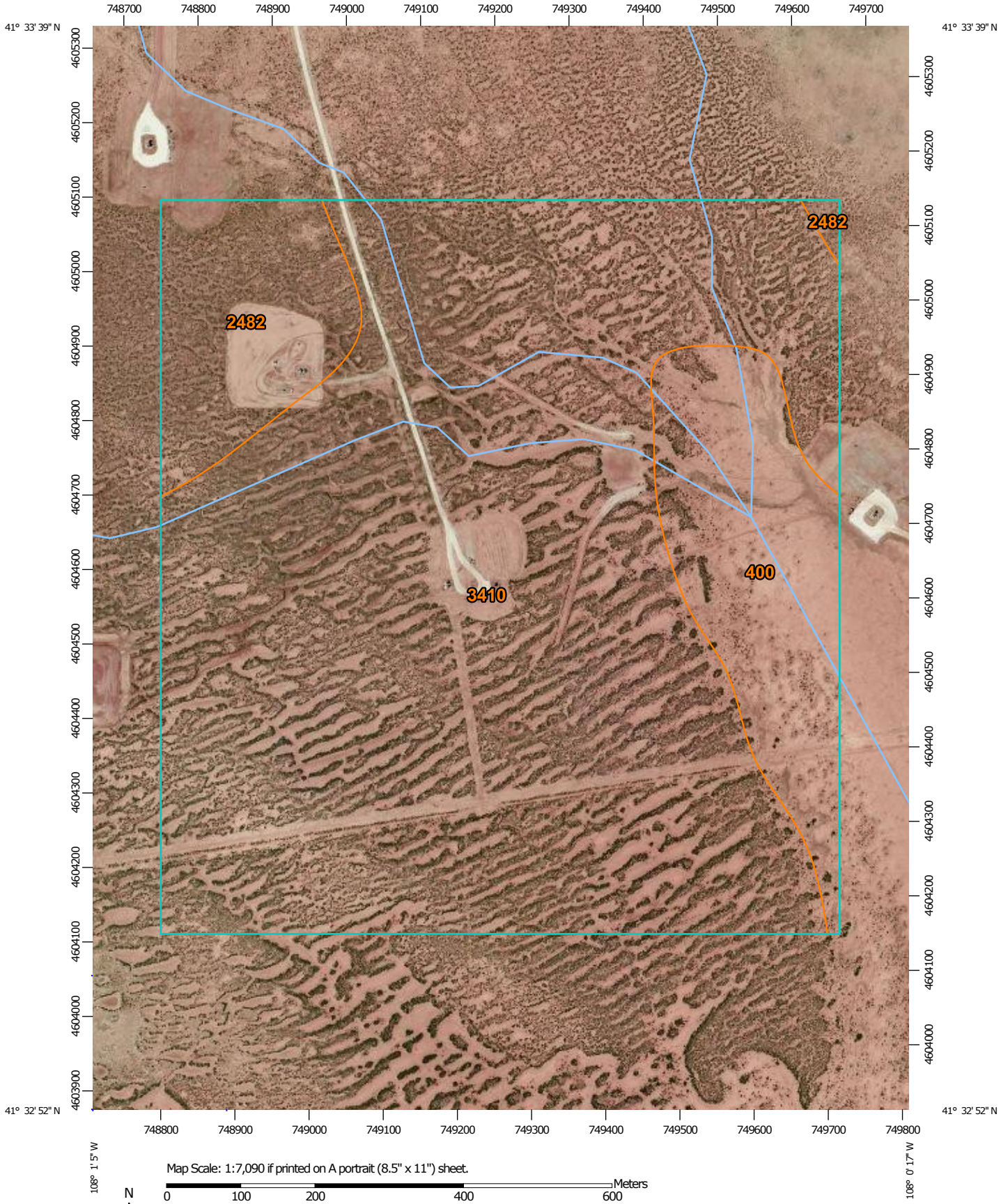
This site shows the most challenges for reclamation potential among the 7 sites visited, according to agency guidelines. Its soils are saline-sodic, with already high levels of calcium levels in the soil, making addition of amendments such as gypsum less likely to decrease sodium levels, and possibly exacerbating high salt levels. Elemental sulfur application at a rate of 3 tons/ acre is recommended for this site (Norton and Strom, 2012; Davis et. al., 2012; USDA, 2014; Horneck et al., 2007). It is suggested that this site be irrigated to increase infiltration of amendments, increase solubility of calcium, and leach sodium through the soil profile. It is also suggested that the gypsum application be combined with the addition of OM, applied at a rate of 3.0 tons/acre.

Although this site's existing OM levels are not exceptionally low for soils typical of this area in WY, OM additions can help soils with saline-sodic conditions by improving overall soil health and water retention capabilities (Norton and Strom, 2012; Faulkner, 2013). If the OM addition chosen is composted manure, testing should be done prior to application to ensure salt levels of the amendment are not elevated.

Red Lakes 8-1

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes 8-1 General Area)



Map Scale: 1:7,090 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sweetwater County Area, Wyoming
Survey Area Data: Version 2, Jan 3, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes 8-1 Soils Map)

Sweetwater County Area, Wyoming

Map Unit: 3410—Chrisman-Debone complex, 0 to 3 percent slopes

Component: Chrisman (41%)

The Chrisman component makes up 41 percent of the map unit. Slopes are 0 to 3 percent. This component is on intermontane basins, playa floors. The parent material consists of lacustrine deposits derived from shale and siltstone. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is high. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY140WY Saline Lowland, Drained (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6s. Irrigated land capability classification is 6s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a moderately saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 7 within 30 inches of the soil surface.

Component: Debone (39%)

The Debone component makes up 39 percent of the map unit. Slopes are 0 to 3 percent. This component is on intermontane basins, playa floors. The parent material consists of alluvium derived from shale and siltstone. Depth to a root restrictive layer, natric, is 1 to 3 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY140WY Saline Lowland, Drained (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 7s. Irrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a moderately saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 16 within 30 inches of the soil surface.

Sweetwater County Area, Wyoming

3410—Chrisman-Debone complex, 0 to 3 percent slopes

Map Unit Setting

- *Elevation:* 6,200 to 7,200 feet
- *Mean annual precipitation:* 7 to 10 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 75 to 105 days

Map Unit Composition

- *Chrisman and similar soils:* 41 percent
- *Debone and similar soils:* 39 percent

Description of Chrisman

Setting

- *Landform:* Playa floors, alluvial flats
- *Landform position (three-dimensional):* Talf
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Lacustrine deposits derived from shale and siltstone

Typical profile

- *AE - 0 to 2 inches:* silty clay loam
- *C1 - 2 to 32 inches:* silty clay
- *C2 - 32 to 79 inches:* silty clay

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 2 percent
- *Salinity, maximum in profile:* Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 12.0
- *Available water storage in profile:* Moderate (about 7.3 inches)

Interpretive groups

- *Land capability classification (irrigated):* 6s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* C
- *Ecological site:* Saline Lowland, Drained (Green River - Great Divide Basins) (R034AY140WY)

Description of Debone

Setting

- *Landform:* Playa floors, alluvial flats
- *Landform position (three-dimensional):* Talf
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Lacustrine deposits derived from shale and siltstone

Typical profile

- *A - 0 to 2 inches:* silty clay loam
- *Btn - 2 to 10 inches:* silty clay loam
- *Bty1 - 10 to 30 inches:* loam
- *Bty2 - 30 to 52 inches:* silty clay loam
- *Bty3 - 52 to 79 inches:* silty clay

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* 1 to 3 inches to natric
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 4 percent
- *Salinity, maximum in profile:* Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 20.0
- *Available water storage in profile:* Very low (about 0.3 inches)

Interpretive groups

- *Land capability classification (irrigated):* 7s
- *Land capability classification (nonirrigated):* 7s
- *Hydrologic Soil Group:* C
- *Ecological site:* Saline Lowland, Drained (Green River - Great Divide Basins) (R034AY140WY)

Red Lakes 8-1 Site Visit

06/26/14 10:03

- 8 subsamples were collected at 0-6 inches and mixed for one composite sample
- Very little to no vegetation on most of site

Red Lakes 8-1 Disturbed Area

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed		**Native**	
CLSE	Rocky Mountain beeplant	SAVE	greasewood
SAVE	greasewood	MONO	povertyweed
		CLSE	Rocky Mountain beeplant
		LOMAT	desert parsley
		SIHY	bottlebrush squirreltail
			unknown mustard

- Soil sample hand- textured on site =silty clay
- Munsell moist color= 2.5 YR 4/6

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
8.5	2.55	1.6	29.3	0.2
Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
1.21	0.61	28.0	400	8.8
Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
0.02	1.57	74.2	10.9	752

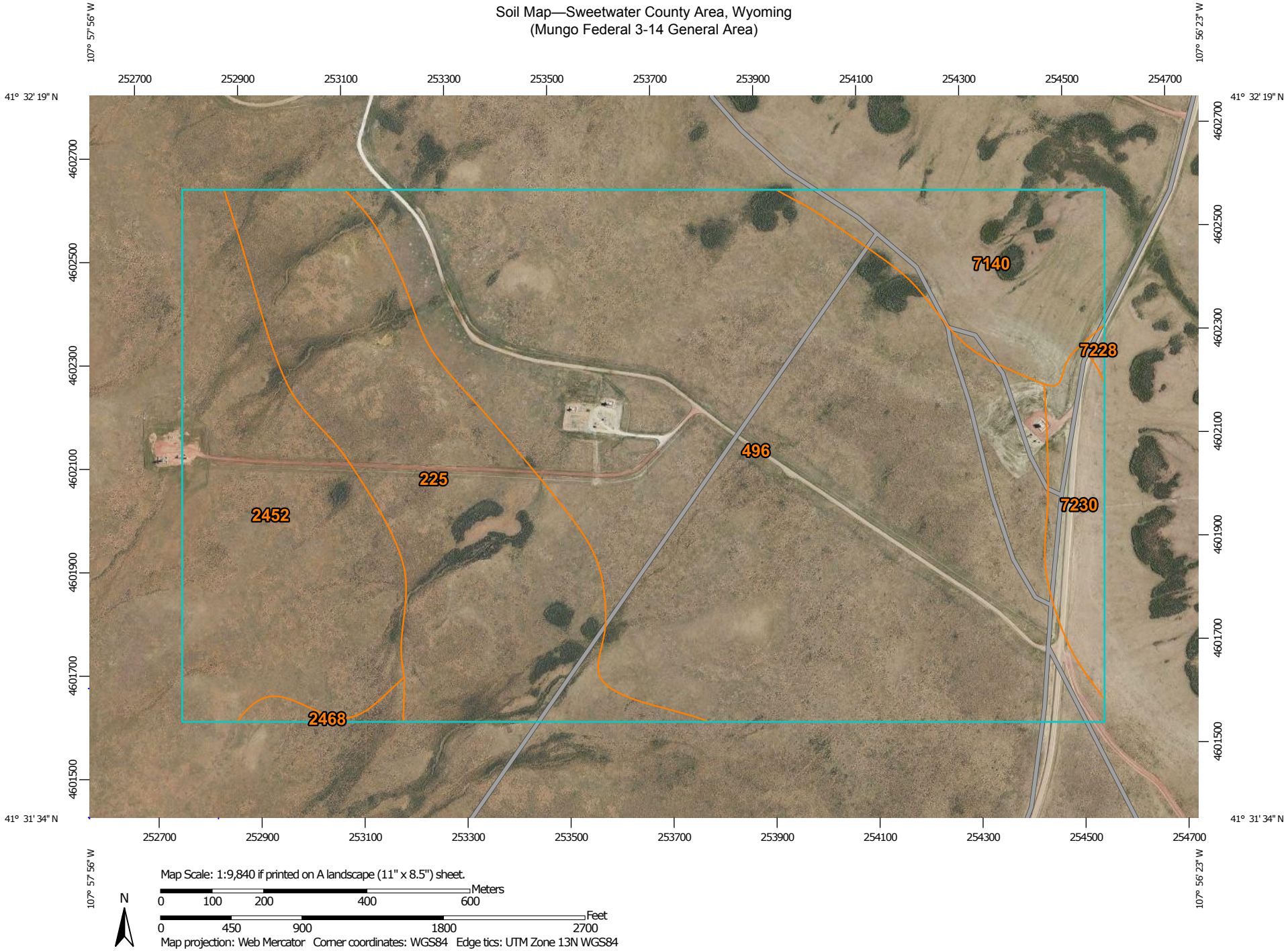
Amendment Recommendations:

Although this site does not have saline-sodic soils, it does have a sodicity problem combined with clay texture. This site was notably void of vegetation, and may prove more difficult to reclaim than any of the other sites visited. If possible, it is recommended that soil with a more desirable loamy texture be brought in and mixed with existing topsoil when this site undergoes reclamation. It is suggested that this site be amended with an incorporated OM addition at a rate of 3 tons/acre (Faulkner, 2013). If time allows, it is recommended that any gypsum application be done only after topsoil dilution and OM incorporation, preferably following 1-2 growing seasons and additional soils testing, to confirm low background calcium levels and persistently high sodium levels. If the SAR and high pH are not ameliorated sufficiently at this time, a gypsum application is recommended at a rate of 5 tons/acre (Horneck et al., 2007).

Mungo Federal 3-14

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Sweetwater County Area, Wyoming
(Mungo Federal 3-14 General Area)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

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The soil surveys that comprise your AOI were mapped at 1:24,000.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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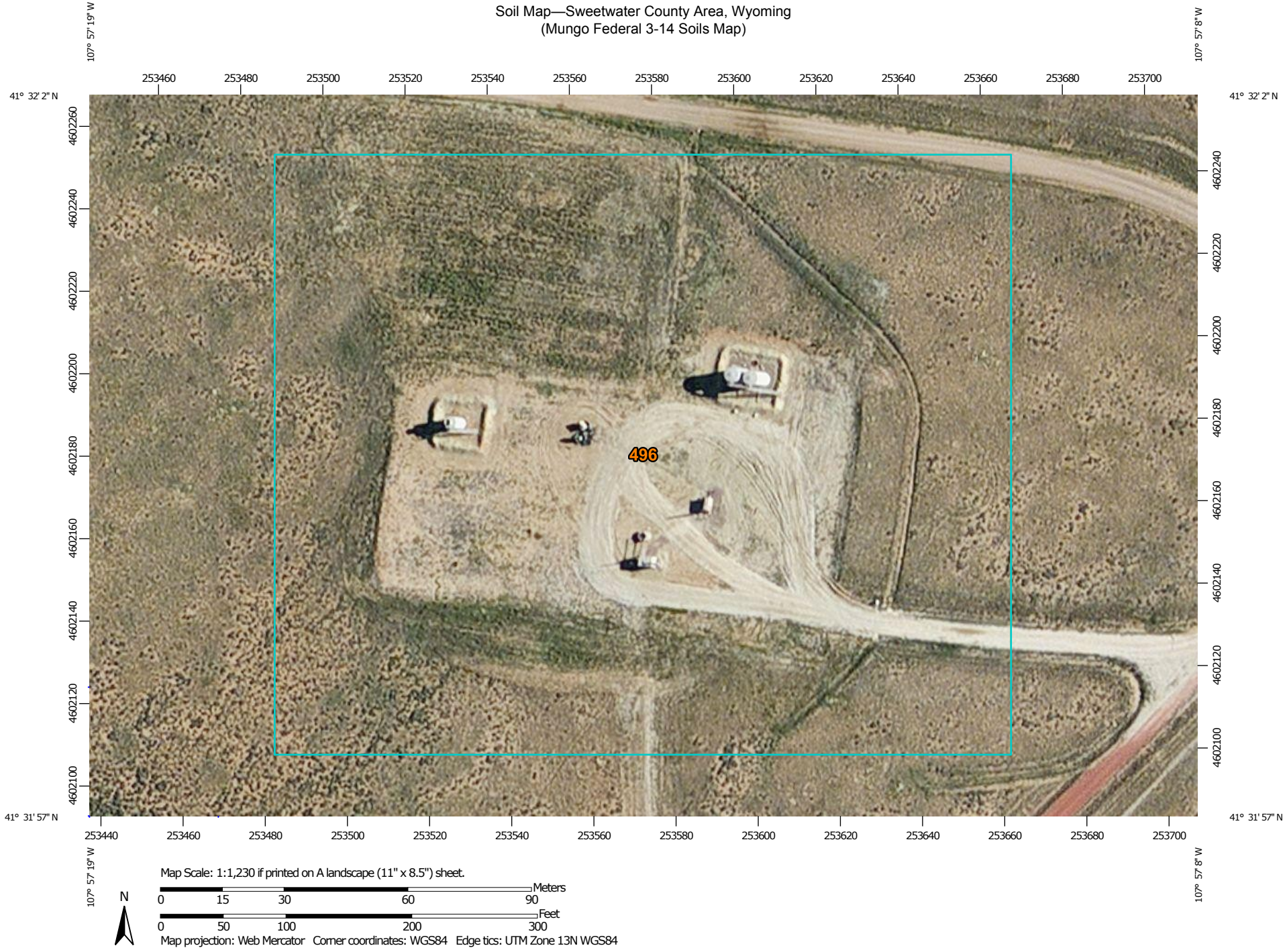
Soil Survey Area: Sweetwater County Area, Wyoming
Survey Area Data: Version 2, Jan 3, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Sweetwater County Area, Wyoming
(Mungo Federal 3-14 Soils Map)



Sweetwater County Area, Wyoming

Map Unit: 496—Sobson-Haterton complex, 2 to 6 percent slopes

Component: Sobson (36%)

The Sobson component makes up 36 percent of the map unit. Slopes are 2 to 6 percent. This component is on intermontane basins, basin-floor remnants. The parent material consists of slope alluvium derived from sandstone and shale over residuum weathered from calcareous sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 22 to 26 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY150WY Sandy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 4s. Irrigated land capability classification is 4s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 7 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Haterton (35%)

The Haterton component makes up 35 percent of the map unit. Slopes are 2 to 6 percent. This component is on intermontane basins, basin-floor remnants. The parent material consists of residuum weathered from sandstone and shale. Depth to a root restrictive layer, bedrock, paralithic, is 14 to 19 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY162WY Shallow Loamy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6s. Irrigated land capability classification is 6s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 15 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Sweetwater County Area, Wyoming

496—Sobson-Haterton complex, 2 to 6 percent slopes

Map Unit Setting

- *Elevation:* 6,200 to 7,200 feet
- *Mean annual precipitation:* 7 to 10 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 75 to 105 days

Map Unit Composition

- *Sobson and similar soils:* 36 percent
- *Haterton and similar soils:* 35 percent

Description of Sobson

Setting

- *Landform:* Basin-floor remnants
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Slope alluvium derived from sandstone and shale over residuum weathered from calcareous sandstone

Typical profile

- *A - 0 to 3 inches:* fine sandy loam
- *Bk - 3 to 12 inches:* fine sandy loam
- *C - 12 to 23 inches:* paragravelly fine sandy loam
- *Cr - 23 to 79 inches:* bedrock

Properties and qualities

- *Slope:* 2 to 6 percent
- *Depth to restrictive feature:* 22 to 26 inches to paralithic bedrock
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high (0.20 to 0.60 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Very low (about 2.8 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 4s
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Ecological site:* Sandy (Green River - Great Divide Basins) (R034AY150WY)

Description of Haterton

Setting

- *Landform:* Basin-floor remnants
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Residuum weathered from sandstone and shale

Typical profile

- *A - 0 to 2 inches:* loam
- *C - 2 to 16 inches:* paragravelly loam
- *Cr - 16 to 79 inches:* bedrock

Properties and qualities

- *Slope:* 2 to 6 percent
- *Depth to restrictive feature:* 14 to 19 inches to paralithic bedrock

- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately high (0.00 to 0.20 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 20 percent
- *Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Very low (about 2.3 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 6s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* D
- *Ecological site:* Shallow Loamy (Green River - Great Divide Basins) (R034AY162WY)

Mungo Federal 3-14 Site Visit

06/26/14 10:03

- 8 subsamples were collected at 0-6 inches and mixed for one composite sample

Mungo Federal 3-14 Disturbed Area

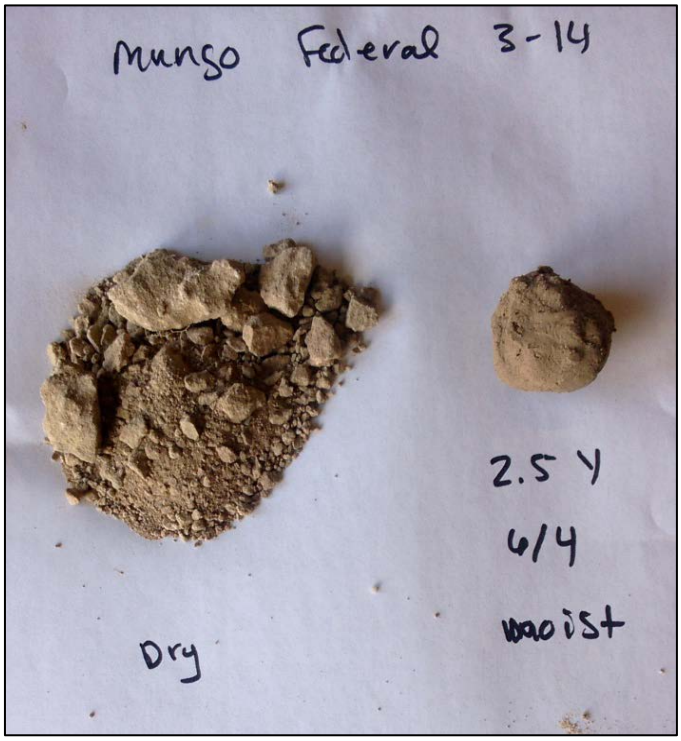
Mungo Federal 3-14 Disturbed Area

Mungo Federal 3-14 Undisturbed Area

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed	
Symbol	*Common Name*
SIHY	bottlebrush squirreltail
AGSM	western wheatgrass
ORHY	indian ricegrass
CHVI	douglas rabbitbrush
BRTE	cheatgrass
AGDA	thickspike wheatgrass
ATGA	Gardner's saltbush
ASTRA	milkvetch
HAGL	halogeton
HOJU	foxtail barley
STCO	needle and threadgrass
CAFI	threadleaf sedge
POSA	Sandberg bluegrass
NAVI	green needlegrass
ARTR	Wyoming big sagebrush
CLSE	Rocky Mountain beeplant

Native	
Symbol	*Common Name*
ATGA	Gardner's saltbush
POSA	Sandberg bluegrass
AGDA	thickspike wheatgrass
CHVI	douglas rabbitbrush
ERIOG	buckwheat
OPPO	pricklypear
ARTR	Wyoming big sagebrush
SIHY	bottlebrush squirreltail
PHHO	spiny phlox



- Soil sample hand- textured on site =silty clay
- Munsell moist color= 2.5 YR 6/4

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
8.1	1.81	1.1	9.22	0.3

Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
3.56	3.25	17.0	742	14.7

Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
0.02	1.11	7.4	7.5	121

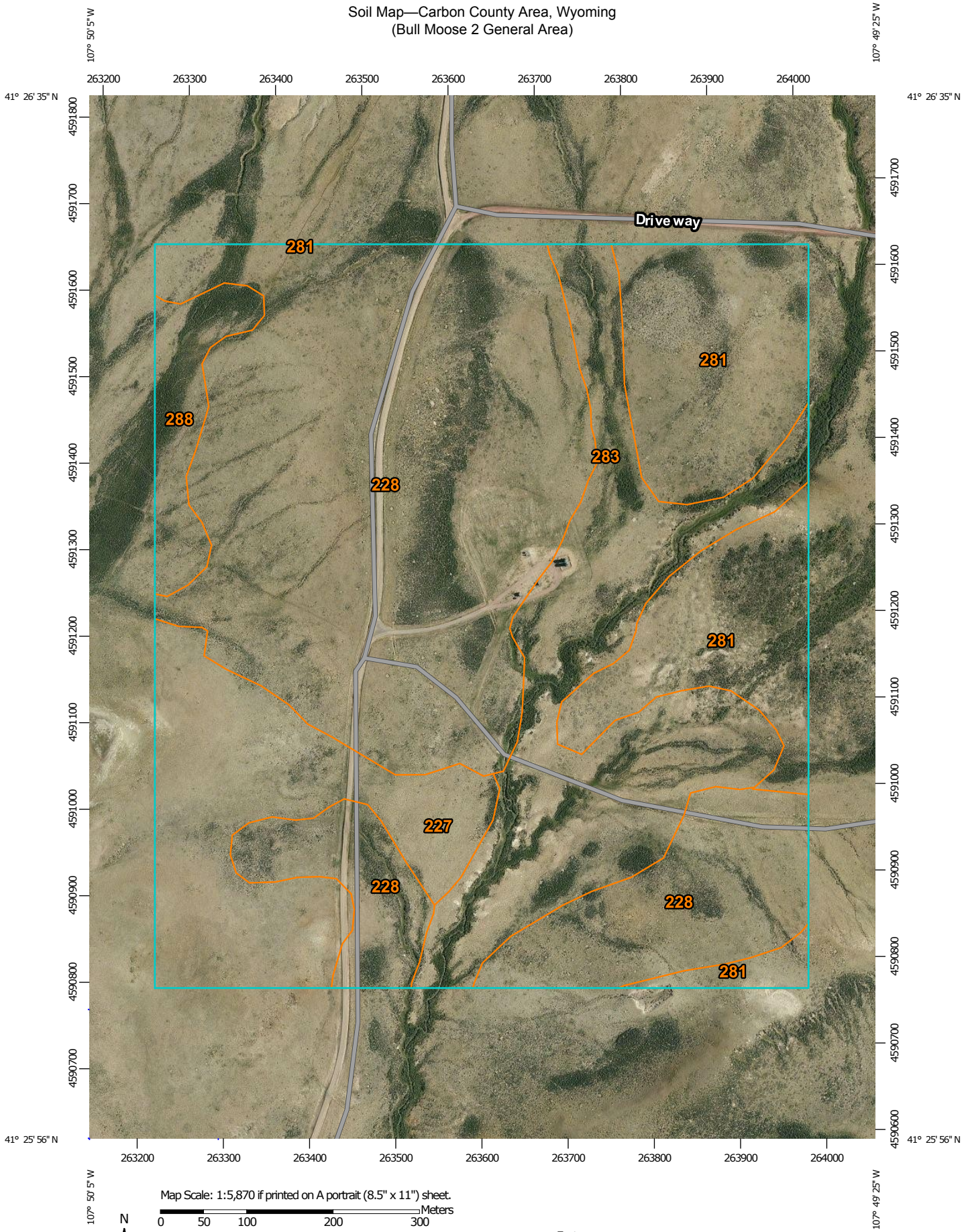
Amendment Recommendations:

This site meets all agency guidelines for suitable topsoil, except having a clay texture. Overall, it has reasonable nutrient levels and OM content. Carbonate and nitrate levels are higher than expected for this site. As nitrate is typically a limiting nutrient for plant growth, nitrate levels are not seen as problematic, but considered when selecting organic additions. As mentioned earlier, excessively high carbonate levels can be an issue, especially for clay textured soils, as this site contains. Amendments for this site include incorporation of straw, which has a high carbon to nitrogen ratio (C:N) into topsoil layers at a rate of 1.0 ton/acre (Faulkner, 2013).

Bull Moose 2

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Carbon County Area, Wyoming
(Bull Moose 2 General Area)



Map Scale: 1:5,870 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

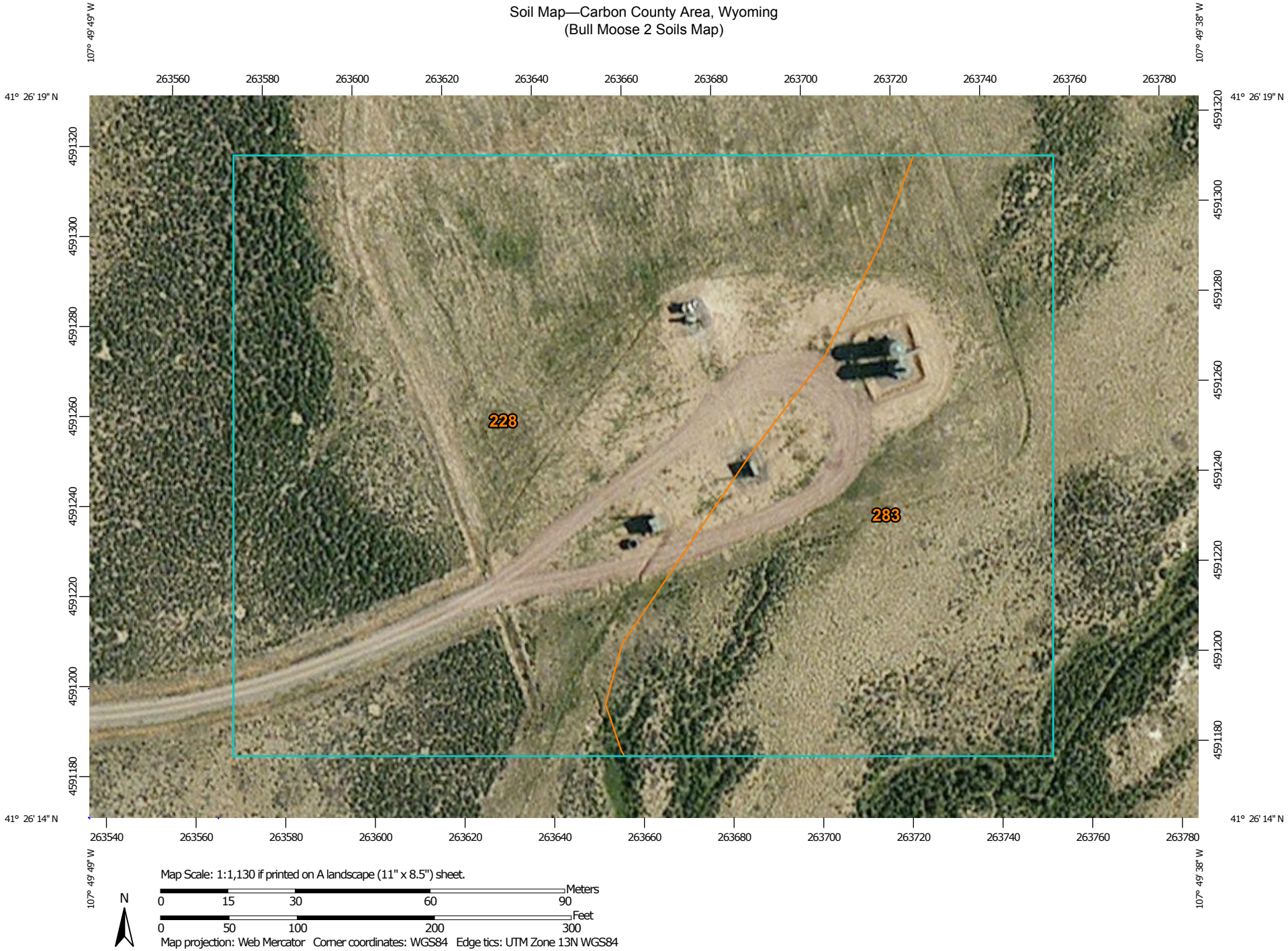
Soil Survey Area: Carbon County Area, Wyoming
Survey Area Data: Version 10, Jan 6, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Carbon County Area, Wyoming
(Bull Moose 2 Soils Map)



Carbon County Area, Wyoming

Map Unit: 228—Tresano-Red Desert complex, 0 to 15 percent slopes

Component: Tresano (50%)

The Tresano component makes up 50 percent of the map unit. Slopes are 1 to 10 percent. This component is on drainageways on basin-floor remnants, basin floors. The parent material consists of alluvium derived from sandstone and shale. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY122WY Loamy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a slightly sodic horizon within 30 inches of the soil surface.

Component: Red Desert (40%)

The Red Desert component makes up 40 percent of the map unit. Slopes are 0 to 10 percent. This component is on basin-floor remnants, basin floors. The parent material consists of alluvium derived from sandstone and shale. Depth to a root restrictive layer, natric, is 4 to 17 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY144WY Saline Upland (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6s. Irrigated land capability classification is 6s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a moderately sodic horizon within 30 inches of the soil surface.

Carbon County Area, Wyoming

228—Tresano-Red Desert complex, 0 to 15 percent slopes

Map Unit Setting

- *Elevation:* 6,500 to 7,000 feet
- *Mean annual precipitation:* 7 to 12 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 65 to 105 days

Map Unit Composition

- *Tresano and similar soils:* 50 percent
- *Red desert and similar soils:* 40 percent

Description of Tresano

Setting

- *Landform:* Drainageways on basin-floor remnants
- *Landform position (two-dimensional):* Backslope
- *Landform position (three-dimensional):* Side slope
- *Down-slope shape:* Linear
- *Across-slope shape:* Concave
- *Parent material:* Alluvium derived from sandstone and shale

Typical profile

- *A - 0 to 7 inches:* loam
- *Bt - 7 to 41 inches:* clay loam
- *2Bk - 41 to 71 inches:* fine sandy loam
- *2Btky - 71 to 80 inches:* sandy clay loam

Properties and qualities

- *Slope:* 1 to 10 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.60 to 2.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 8 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 12.0
- *Available water storage in profile:* High (about 10.7 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 6e
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* B
- *Ecological site:* Loamy (Green River - Great Divide Basins) (R034AY122WY)

Description of Red Desert

Setting

- *Landform:* Basin-floor remnants
- *Landform position (two-dimensional):* Toeslope
- *Landform position (three-dimensional):* Interfluve
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Alluvium derived from sandstone and shale

Typical profile

- *A - 0 to 9 inches:* loam
- *Bt - 9 to 17 inches:* loam

- *Btnz - 17 to 33 inches:* clay loam
- *Btknyz - 33 to 46 inches:* loam
- *By - 46 to 80 inches:* loam

Properties and qualities

- *Slope:* 0 to 10 percent
- *Depth to restrictive feature:* 4 to 17 inches to natric
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high (0.20 to 0.60 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 4 percent
- *Gypsum, maximum in profile:* 8 percent
- *Salinity, maximum in profile:* Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 20.0
- *Available water storage in profile:* Very low (about 2.7 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 6s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* C
- *Ecological site:* Saline Upland (Green River - Great Divide Basins) (R034AY144WY)

Map Unit: 283—Sandbranch-Dines overflow complex, 0 to 3 percent slopes

Component: Sandbranch (70%)

The Sandbranch component makes up 70 percent of the map unit. Slopes are 0 to 3 percent. This component is on plateaus, drainageways. The parent material consists of alluvium derived from sedimentary rock. Depth to a root restrictive layer inches , salic,. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY140WY Saline Lowland, Drained (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 7s. Irrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a strongly saline horizon within 30 inches of the soil surface. The soil has a moderately sodic horizon within 30 inches of the soil surface.

Component: Dines, overflow (20%)

The Dines, overflow component makes up 20 percent of the map unit. Slopes are 0 to 3 percent. This component is on drainageways, plateaus. The parent material consists of alluvium derived from sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY140WY Saline Lowland, Drained (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 6s. Irrigated land capability classification is 6s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a slightly sodic horizon within 30 inches of the soil surface.

Carbon County Area, Wyoming

283—Sandbranch-Dines overflow complex, 0 to 3 percent slopes

Map Unit Setting

- *Elevation:* 19,680 to 22,960 feet
- *Mean annual precipitation:* 7 to 12 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 65 to 105 days

Map Unit Composition

- *Sandbranch and similar soils:* 70 percent
- *Dines, overflow, and similar soils:* 20 percent

Description of Sandbranch

Setting

- *Landform:* Drainageways
- *Landform position (two-dimensional):* Toeslope
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Linear
- *Across-slope shape:* Concave
- *Parent material:* Alluvium derived from sedimentary rock

Typical profile

- *A - 0 to 4 inches:* fine sandy loam
- *Btkn - 4 to 17 inches:* loam
- *Btn - 17 to 27 inches:* loam
- *Bn - 27 to 47 inches:* loam
- *Bky - 47 to 60 inches:* loam

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches; More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.60 to 2.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 5 percent
- *Salinity, maximum in profile:* Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 25.0
- *Available water storage in profile:* Very low (about 0.5 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 7s

- *Land capability classification (nonirrigated):* 7s
- *Hydrologic Soil Group:* B
- *Ecological site:* Saline Lowland, Drained (Green River - Great Divide Basins) (R034AY140WY)

Description of Dines, Overflow

Setting

- *Landform:* Drainageways
- *Down-slope shape:* Linear
- *Across-slope shape:* Concave
- *Parent material:* Alluvium derived from sedimentary rock

Typical profile

- *A - 0 to 5 inches:* fine sandy loam
- *C1 - 5 to 24 inches:* fine sandy loam
- *C2 - 24 to 60 inches:* fine sandy loam

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* Frequent
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 1 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 12.0
- *Available water storage in profile:* Moderate (about 8.4 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 6s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* B
- *Ecological site:* Saline Lowland, Drained (Green River - Great Divide Basins) (R034AY140WY)

Bull Moose 2 Site Visit

06/26/14 13.06

- 8 subsamples were collected at 0-6 inches and mixed for one composite sample
- Equipment may still be active

Bull Moose 2 Disturbed Area

Bull Moose 2 Disturbed Area

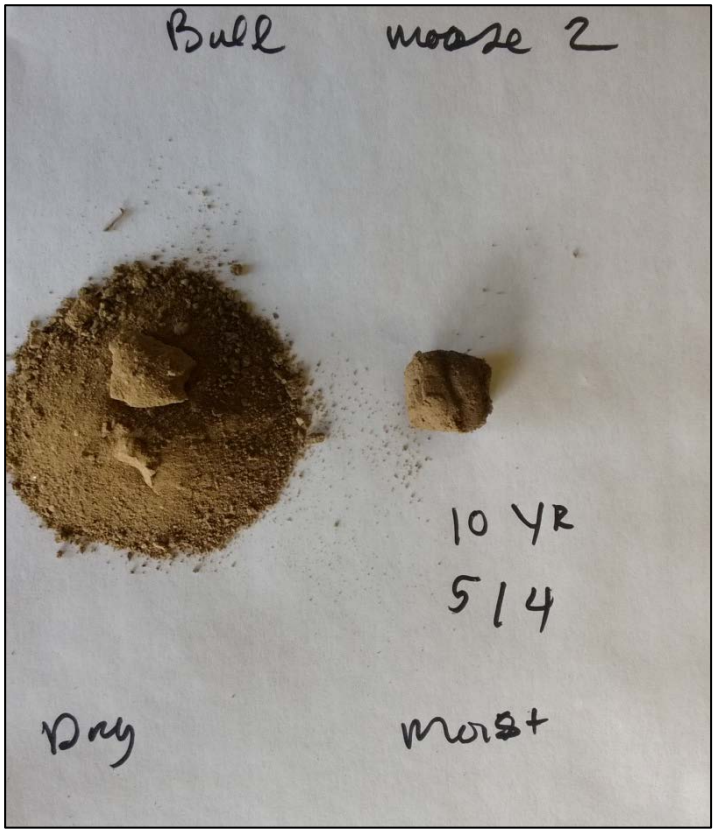
Bull Moose 2 Disturbed Area

Bull Moose 2 Reclaimed Area

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed	
Symbol	*Common Name*
AGSM	western wheatgrass
ORHY	indian ricegrass
ATGA	Gardner's saltbush
HAGL	halogeton
STCO	needle and threadgrass
POSA	Sandberg bluegrass
NAVI	green needlegrass
ARTR	Wyoming big sagebrush
CLSE	Rocky Mountain beeplant
SAKA	Russian thistle
ATCA	saltbush
GUSA	broom snakeweed
SAVE	greasewood

Native	
Symbol	*Common Name*
ATGA	Gardner's saltbush
POSA	Sandberg bluegrass
OPPO	pricklypear
ARTR	Wyoming big sagebrush
SIHY	bottlebrush squirreltail
PHHO	spiny phlox
ORHY	indian ricegrass
GUSA	broom snakeweed



- Soil sample hand- textured on site =sandy clay
- Munsell moist color= 10YR 5/4

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
7.9	0.80	0.4	2.39	1.0

Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
3.79	1.21	3.79	102	4.5

Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.62	16.8	14.8	283

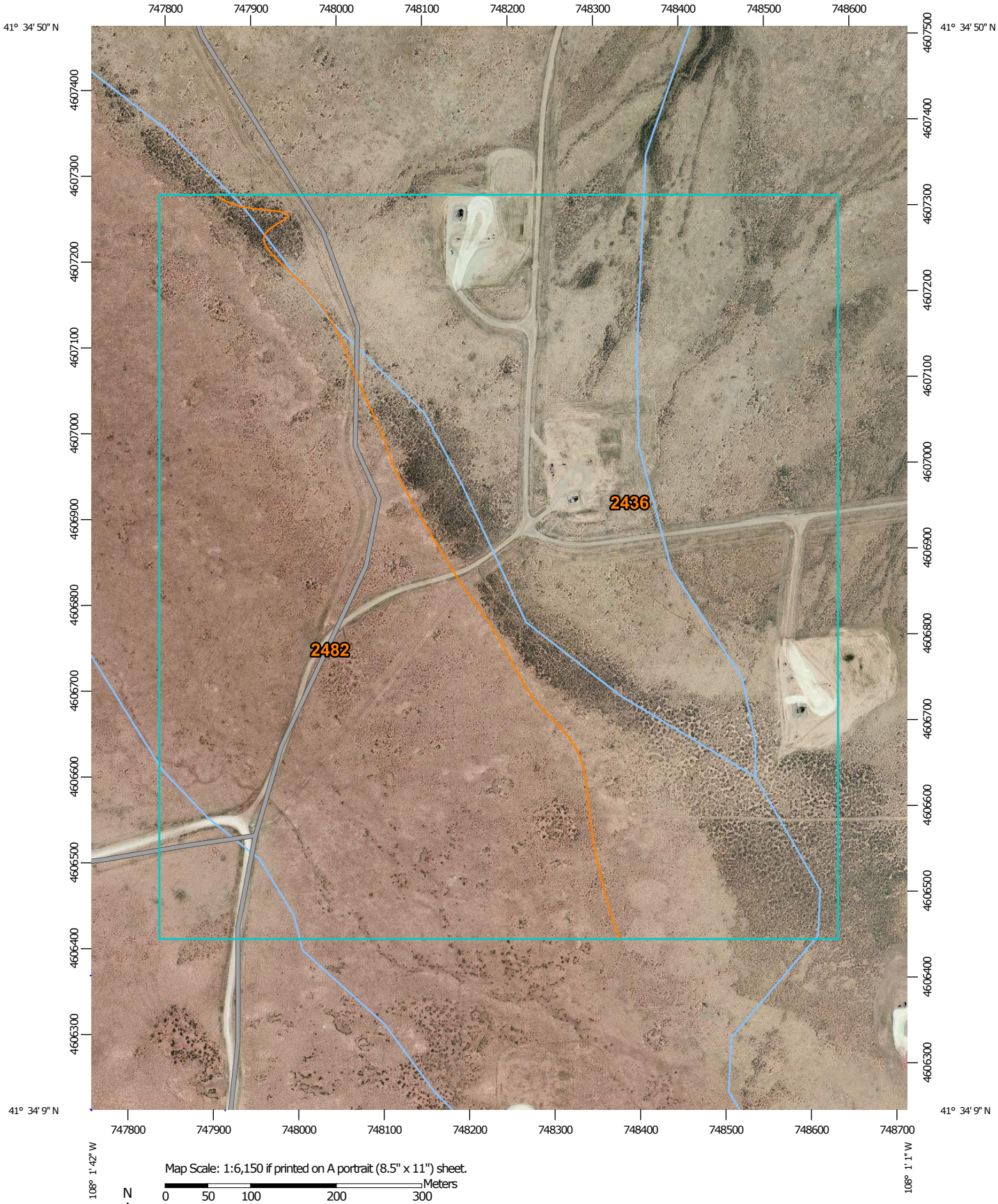
Amendment Recommendations:

The only agency guideline for topsoil that this site does not meet is having clay textured soils. The OM content is also low and an OM addition incorporated at 2.45 tons/acre (see Robber's Bluff 3-3 for assumptions and calculation) is recommended. Other measured parameters are appropriate for this area and conducive to reclamation.

Red Lakes 1-32

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes 1-32 General Area)



Map Scale: 1:6,150 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

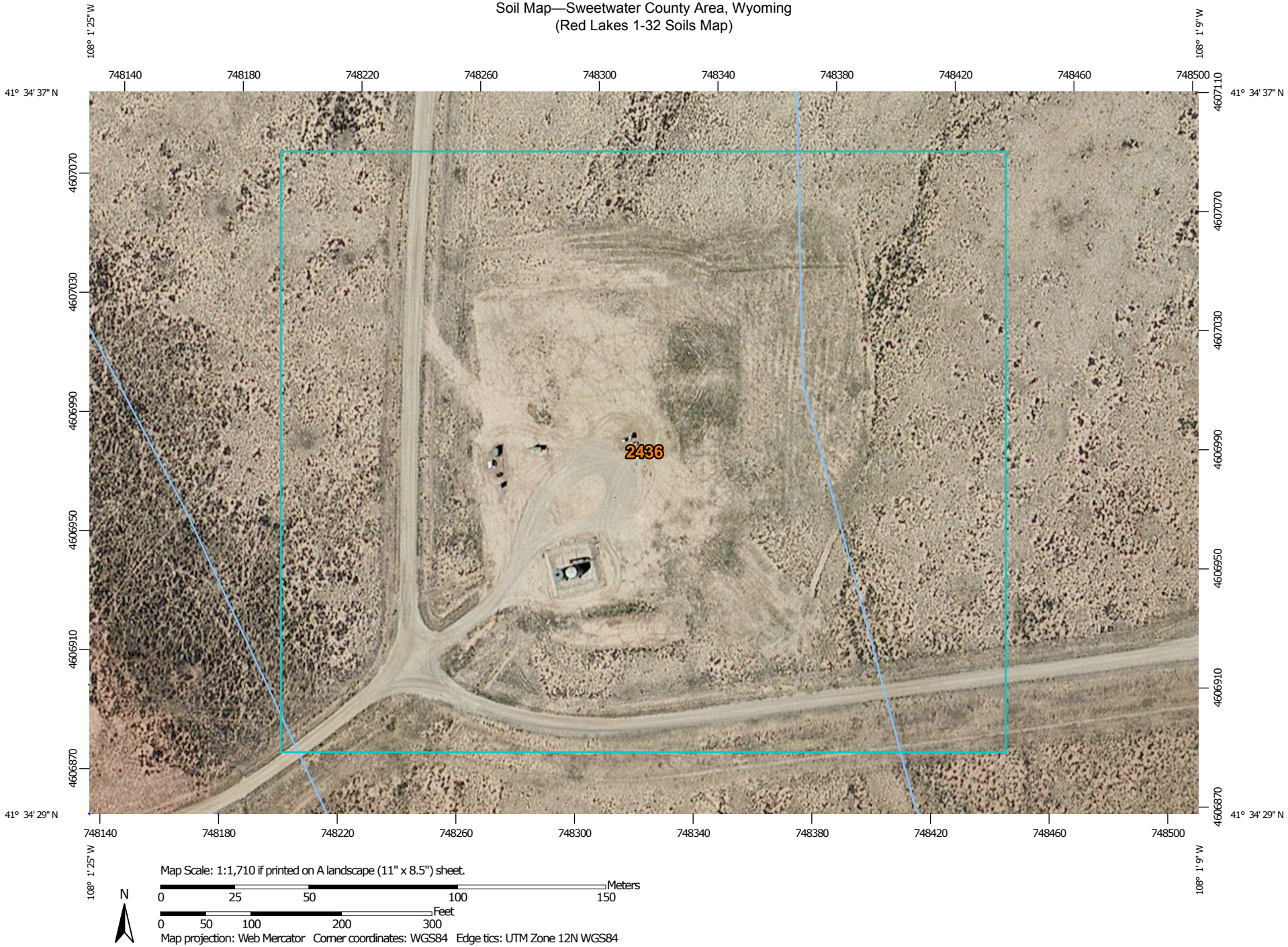
Soil Survey Area: Sweetwater County Area, Wyoming
Survey Area Data: Version 2, Jan 3, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes 1-32 Soils Map)



Sweetwater County Area, Wyoming

Map Unit: 2436—Pepal-Teagulf complex, 0 to 6 percent slopes

Component: Pepal (45%)

The Pepal component makes up 45 percent of the map unit. Slopes are 0 to 6 percent. This component is on intermontane basins, mesas. The parent material consists of residuum weathered from calcareous sandstone. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY150WY Sandy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 4s. Irrigated land capability classification is 4s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 12 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Teagulf (40%)

The Teagulf component makes up 40 percent of the map unit. Slopes are 0 to 6 percent. This component is on mesas, intermontane basins. The parent material consists of residuum weathered from calcareous sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 30 to 41 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY150WY Sandy (green River - Great Divide Basins) ecological site. Nonirrigated land capability classification is 4s. Irrigated land capability classification is 4s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 15 percent. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Sweetwater County Area, Wyoming

2436—Pepal-Teagulf complex, 0 to 6 percent slopes

Map Unit Setting

- *Elevation:* 6,200 to 7,000 feet
- *Mean annual precipitation:* 7 to 9 inches
- *Mean annual air temperature:* 40 to 44 degrees F
- *Frost-free period:* 75 to 105 days

Map Unit Composition

- *Pepal and similar soils:* 45 percent
- *Teagulf and similar soils:* 40 percent

Description of Pepal

Setting

- *Landform:* Mesas, dip slopes on cuestas

- *Landform position (three-dimensional):* Tread
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Residuum weathered from calcareous sandstone

Typical profile

- *A - 0 to 6 inches:* fine sandy loam
- *Bw - 6 to 15 inches:* fine sandy loam
- *Bk - 15 to 39 inches:* fine sandy loam
- *C - 39 to 79 inches:* fine sandy loam

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 20 percent
- *Salinity, maximum in profile:* Nonsaline to slightly saline (2.0 to 5.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Moderate (about 6.6 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 4s
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* A
- *Ecological site:* Sandy (Green River - Great Divide Basins) (R034AY150WY)

Description of Teagulf

Setting

- *Landform:* Mesas, dip slopes on cuestas
- *Landform position (three-dimensional):* Tread
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Residuum weathered from calcareous sandstone

Typical profile

- *A - 0 to 3 inches:* fine sandy loam
- *Bw - 3 to 10 inches:* fine sandy loam
- *Bk - 10 to 26 inches:* fine sandy loam
- *BCk - 26 to 35 inches:* fine sandy loam
- *Cr - 35 to 79 inches:* bedrock

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* 30 to 41 inches to paralithic bedrock
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high (0.00 to 0.28 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 20 percent
- *Salinity, maximum in profile:* Nonsaline to slightly saline (2.0 to 5.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Low (about 4.5 inches)

Interpretive groups

- *Farmland classification:* Not prime farmland
- *Land capability classification (irrigated):* 4s
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Ecological site:* Sandy (Green River - Great Divide Basins) (R034AY150WY)

Red Lakes 1-32 Site Visit

06/26/14 08:56

- 4 subsamples were collected at 0-6 inches and mixed for one composite sample from topsoil pile
- 2 subsamples were collected at 0-6 inches and mixed for one composite sample from disturbed area

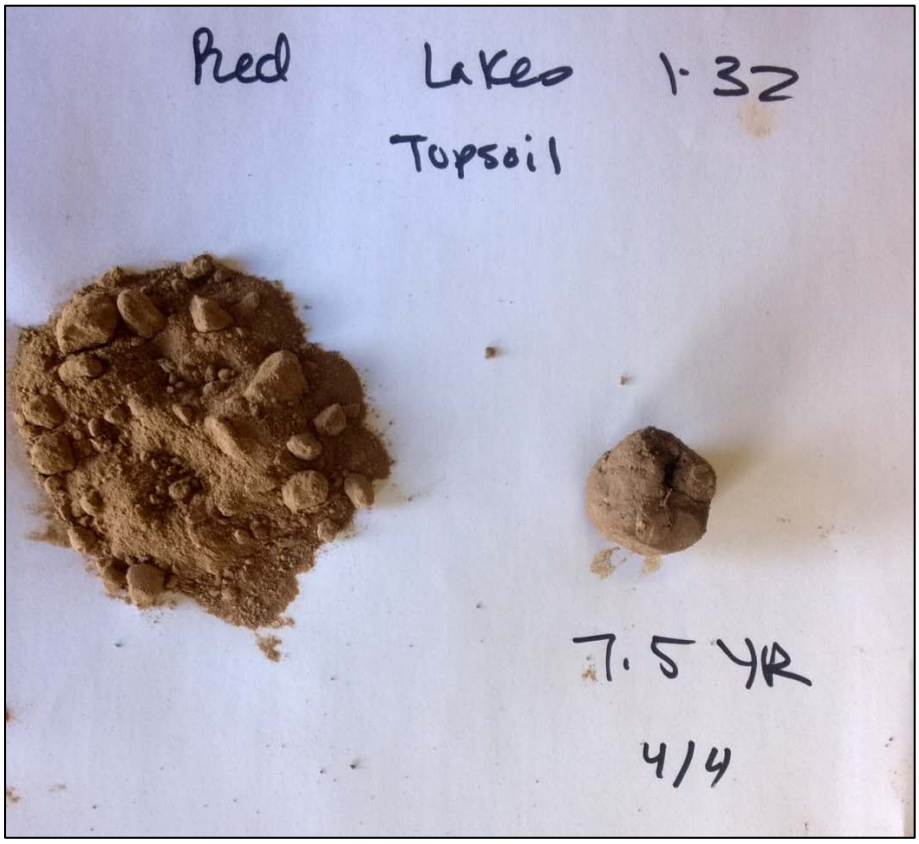
Red Lakes 1-32 Topsoil Pile

Red Lakes 1-32 Disturbed Area

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed	
Symbol	*Common Name*
SIHY	bottlebrush squirreltail
AGSM	western wheatgrass
ORHY	indian ricegrass
CHVI	douglas rabbitbrush
BRTE	cheatgrass
ATGA	Gardner's saltbush
HAGL	halogeton
HOJU	foxtail barley
POSA	Sandberg bluegrass
GUSA	broom snakeweed
CLSE	Rocky Mountain beeplant
HORDE	unknown barley

Native	
Symbol	*Common Name*
ATGA	Gardner's saltbush
ORHY	indian ricegrass
KRLA	winterfat
POSA	Sandberg bluegrass
AGSM	western wheatgrass
CHVI	douglas rabbitbrush
OPPO	pricklypear
ARTR	Wyoming big sagebrush
PHHO	spiny phlox
SIHY	bottlebrush squirreltail
GUSA	broom snakeweed
POFE	muttongrass
ARPE	birdfoot sagebrush
	unknown penstemon



- Soil sample hand- textured on site =clay
- Munsell moist color= 7.5 YR 4/4

Red Lakes 1-32 Topsoil Pile Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
8.0	0.72	1.2	3.30	0.7
Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
2.32	0.92	4.20	66	4.8
Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.66	14.9	17.0	404

- Soil sample hand- textured on site =clay
- Munsell moist color= 10 YR 4/4

Red Lakes 1-32 Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
7.6	1.43	1.2	0.40	1.8
Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
11.5	4.51	1.14	92	2.5
Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.59	47.2	17.8	582

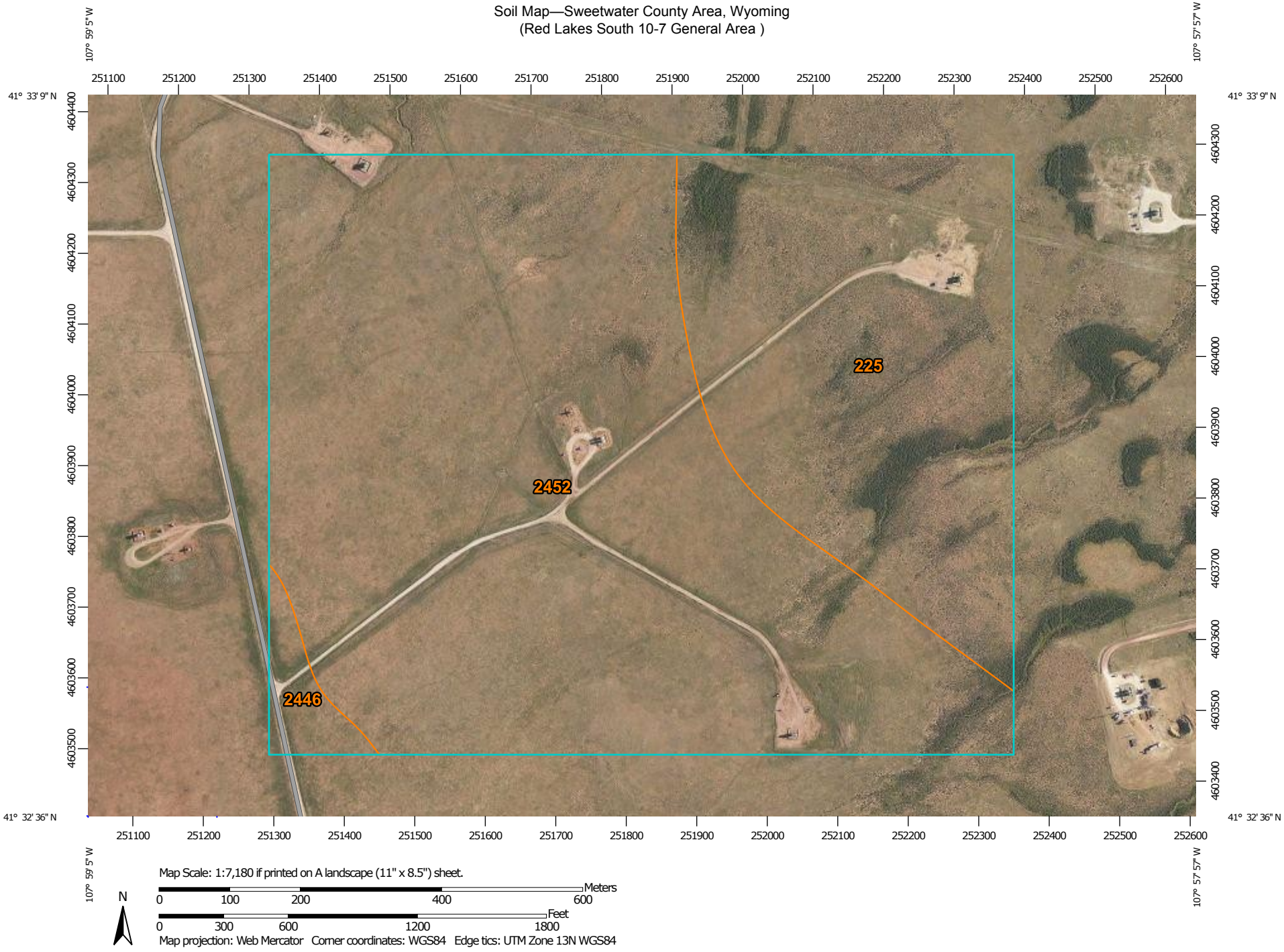
Amendment Recommendations:

The only agency guideline this site does not meet for suitable topsoil is having clay textured soils. All other parameters look appropriate for landscapes in this area. Therefore, the only additional amendment recommendation, other than those outlined above for all sites, includes a surface straw or hay mulch applied at 1 ton/acre, and crimped or disced into soil following reseeding.

Red Lakes 10-7

- ***NRCS General Area Soils Map***
- ***NRCS Area of Interest Soils Map***
- ***Site Visit Data***
- ***Lab Data***
- ***Site Specific Amendment Recommendation***

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes South 10-7 General Area)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

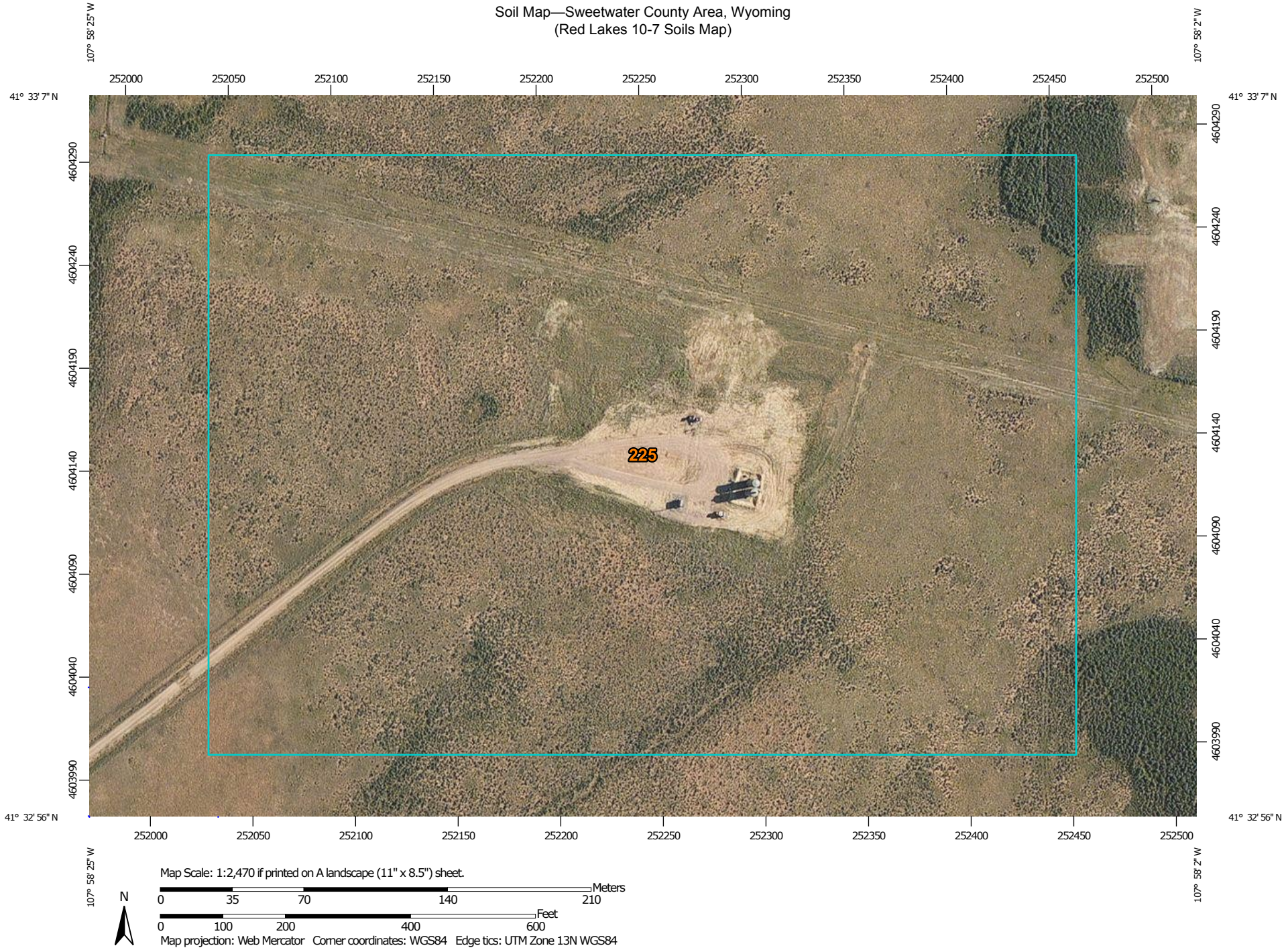
Soil Survey Area: Sweetwater County Area, Wyoming
Survey Area Data: Version 2, Jan 3, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2010—Jul 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map—Sweetwater County Area, Wyoming
(Red Lakes 10-7 Soils Map)



Sweetwater County Area, Wyoming

Map Unit: 225—Cushool-Rock River complex, 2 to 12 percent slopes

Component: Rock River (45%)

The Rock River component makes up 45 percent of the map unit. Slopes are 2 to 12 percent. This component is on benches, intermontane basins. The parent material consists of alluvium derived from igneous, metamorphic and sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY322WY Loamy (high Plains Southeast) ecological site. Nonirrigated land capability classification is 6s. Irrigated land capability classification is 6s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 7 within 30 inches of the soil surface.

Component: Cushool (35%)

The Cushool component makes up 35 percent of the map unit. Slopes are 2 to 12 percent. This component is on intermontane basins, dip slopes on cuestas. The parent material consists of alluvium derived from igneous and sedimentary rock over residuum weathered from sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 41 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R034AY322WY Loamy (high Plains Southeast) ecological site. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Sweetwater County Area, Wyoming

225—Cushool-Rock River complex, 2 to 12 percent slopes

Map Unit Setting

- *Elevation:* 6,500 to 7,500 feet
- *Mean annual precipitation:* 8 to 12 inches
- *Mean annual air temperature:* 42 to 46 degrees F
- *Frost-free period:* 85 to 115 days

Map Unit Composition

- *Rock river and similar soils:* 45 percent
- *Cushool and similar soils:* 35 percent

Description of Rock River

Setting

- *Landform:* Alluvial fans, fan remnants, benches, dip slopes on cuestas, pediments
- *Landform position (two-dimensional):* Footslope
- *Landform position (three-dimensional):* Mountainbase, tread
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

- *A - 0 to 5 inches:* fine sandy loam
- *Bt - 5 to 12 inches:* sandy clay loam
- *Bk - 12 to 28 inches:* sandy loam
- *C - 28 to 80 inches:* sandy loam

Properties and qualities

- *Slope:* 2 to 12 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.60 to 2.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 1 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 12.0
- *Available water storage in profile:* Moderate (about 7.7 inches)

Interpretive groups

- *Land capability classification (irrigated):* 6s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* B
- *Ecological site:* Loamy (High Plains Southeast) (R034AY322WY)

Description of Cushool

Setting

- *Landform:* Benches, pediments, dip slopes on cuestas
- *Landform position (two-dimensional):* Footslope
- *Landform position (three-dimensional):* Tread
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Alluvium derived from igneous and sedimentary rock over residuum weathered from sandstone

Typical profile

- *A - 0 to 3 inches:* fine sandy loam
- *Bt - 3 to 15 inches:* loam
- *Btk - 15 to 21 inches:* sandy clay loam
- *Bk - 21 to 28 inches:* sandy loam
- *Cr - 28 to 80 inches:* weathered bedrock

Properties and qualities

- *Slope:* 2 to 12 percent
- *Depth to restrictive feature:* 20 to 41 inches to paralithic bedrock
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high (0.20 to 0.60 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 10 percent
- *Gypsum, maximum in profile:* 1 percent
- *Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum in profile:* 3.0
- *Available water storage in profile:* Low (about 4.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* 4e
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* C
- *Ecological site:* Loamy (High Plains Southeast) (R034AY322WY)

Red Lakes 10-7 Site Visit

06/26/14 11:18

- 9 subsamples were collected at 0-6 inches and mixed for one composite sample
- Existing reclamation will not be re-disturbed

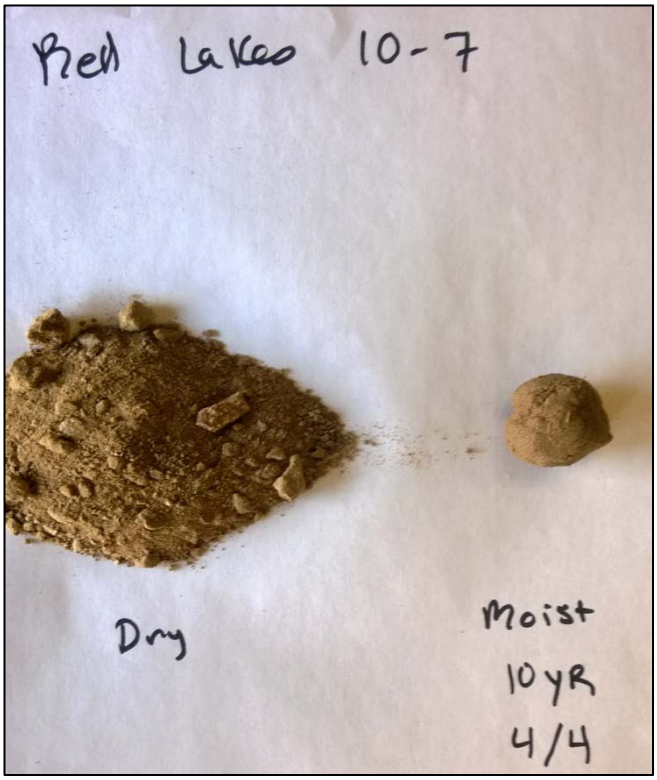
Red Lakes 10-7 Disturbed Area

Red Lakes 10-7

Red Lakes 10-7

Observed Vegetation On Site (collected by P. Guernsey 06/26/14)

Reclaimed/Disturbed		**Native**	
Symbol	*Common Name*	*Symbol*	*Common Name*
SIHY	bottlebrush squirreltail	ATGA	Gardner's saltbush
AGSM	western wheatgrass	KRLA	winterfat
ORHY	indian ricegrass	POSA	Sandberg bluegrass
CHVI	douglas rabbitbrush	ERIOG	buckwheat
AGDA	thickspike wheatgrass	OPPO	pricklypear
ATGA	Gardner's saltbush	ARTR	Wyoming big sagebrush
HAGL	halogeton	SIHY	bottlebrush squirreltail
STCO	needle and threadgrass	ORHY	indian ricegrass
KRLA	winterfat	ERIGE	fleabane
MACA	tansyaster	PHHO	spiny phlox
CLSE	Rocky Mountain beeplant	AGSM	western wheatgrass
POSA	Sandberg bluegrass	OXYTR	locoweed
NAVI	green needlegrass	STAR	thrift mock goldenweed
CHNA	rubber rabbitbrush		



- Soil sample hand- textured on site =sandy loam
- Munsell moist color= 10YR 4/4

Analytical Results (IML)

pH	*EC (dS/m)*	*OM (%)*	*SAR*	*Coarse Fragment (%)*
7.9	2.48	0.4	6.20	1.8

Ca (meq/L)	*Mg (meq/L)*	*Na (meq/L)*	*SO_4^- (ppm)*	*CO_3^- (%)*
12.1	5.64	18.5	1780	7.4

Se (ppm)	*B (ppm)*	*NO_3^- (ppm)*	*P (ppm)*	*Available K (ppm)*
<0.02	0.59	10.0	5.9	96

Amendment Recommendations:

This site meets all agency guidelines for suitable topsoil. Organic matter and phosphorous levels are low, however. Again the 2.45 tons/acre of OM is suggested as an amendment (see Robber's Bluff 3-3 for assumptions and calculations). This addition should help improve low nutrient levels, as well as increase OM levels to a range more conducive to reclamation.

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APPENDIX I

Ecological Site Description Vegetation Lists

Site ID: R034AY144WY Ecological Site Description Vegetation List

(Robber's Bluff 3-3; Red Lakes 8-1; Bull Moose 2)

Common name	Symbol	Scientific name
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
Indian ricegrass	ACHY	Achnatherum hymenoides
Grass, perennial	2GP	
needle and thread, needleandthread	HECO26	Hesperostipa comata
saline wildrye, salina wildrye	LESA4	Leymus salinus
western wheatgrass	PASM	Pascopyrum smithii
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
Forb, perennial	2FP	
milkvetch	ASTRA	Astragalus
fleabane	ERIGE2	Erigeron
buckwheat	ERIOG	Eriogonum
tufted evening-primrose	OECA10	Oenothera caespitosa
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
phlox	PHLOX	Phlox
princesplume	STANL	Stanleya
woodyaster	XYLOR	Xylorhiza
deathcamas	ZIGAD	Zigadenus
Gardner's saltbush	ATGA	Atriplex gardneri
bud sagebrush, bud sagewort	PIDE4	Picrothamnus desertorum
birdfoot sagebrush	ARPE6	Artemisia pedatifida
winterfat	KRLA2	Krascheninnikovia lanata
greasewood	SAVE4	Sarcobatus vermiculatus

Site ID: R034AY122WY Ecological Site Description Vegetation List

(Robber's Bluff 3-3; Red Lakes 8-1; Bull Moose 2)

Common name	Symbol	Scientific name
streambank wheatgrass, thickspike wheatgrass	ELLAL	Elymus lanceolatus
Indian ricegrass	ACHY	Achnatherum hymenoides
needle and thread, needleandthread	HECO26	Hesperostipa comata
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
prairie Junegrass	KOMA	Koeleria macrantha
Grass, perennial	2GP	
needleleaf sedge	CADU6	Carex duriuscula
threadleaf sedge	CAFI	Carex filifolia
plains reedgrass	CAMO	Calamagrostis montanensis
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
Forb, perennial	2FP	
common yarrow, western yarrow, yarrow	ACMI2	Achillea millefolium
rosy pussytoes, rose pussytoes	ANRO2	Antennaria rosea
milkvetch	ASTRA	Astragalus
Indian paintbrush, paintbrush	CASTI2	Castilleja
tapertip hawksbeard	CRAC2	Crepis acuminata
larkspur	DELPH	Delphinium
fleabane	ERIGE2	Erigeron
buckwheat	ERIOG	Eriogonum
aster	EUCEP2	Eucephalus
toadflax	LINAR	Linaria
granite prickly phlox, sagebrush gilia	LIPU11	Linanthus pungens
desertparsley, biscuitroot	LOMAT	Lomatium
beardtongue, penstemon	PENST	Penstemon
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
stemless mock goldenweed	STAC	Stenotus acaulis
clover	TRIFO	Trifolium
deathcamas	ZIGAD	Zigadenus
big sagebrush	ARTR2	Artemisia tridentata
prairie sagewort, fringed sagewort	ARFR4	Artemisia frigida
shadscale saltbush	ATCO	Atriplex confertifolia
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	CHVI8	Chrysothamnus viscidiflorus
spiny hopsage	GRSP	Grayia spinosa
winterfat	KRLA2	Krascheninnikovia lanata
bud sagebrush, bud sagewort	PIDE4	Picrothamnus desertorum

Site ID: R034AY150WY Ecological Site Description Vegetation List

(Red Lakes 12-5; Red Lakes 1-32; Mungo Federal 3-14)

Common name	Symbol	Scientific name
needle and thread, needleandthread	HECO26	Hesperostipa comata
Indian ricegrass	ACHY	Achnatherum hymenoides
streambank wheatgrass, thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
bluebunch wheatgrass	PSSP6	Pseudoroegneria spicata
Grass, perennial	2GP	
Letterman's needlegrass	ACLE9	Achnatherum lettermanii
threeawn	ARIST	Aristida
needleleaf sedge	CADU6	Carex duriuscula
plains reedgrass	CAMO	Calamagrostis montanensis
prairie Junegrass	KOMA	Koeleria macrantha
galleta grass	PLEUR12	Pleuraphis
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
sand dropseed	SPCR	Sporobolus cryptandrus
Forb, perennial	2FP	
common yarrow, western yarrow, yarrow	ACMI2	Achillea millefolium
rosy pussytoes, rose pussytoes	ANRO2	Antennaria rosea
milkvetch	ASTRA	Astragalus
Indian paintbrush, paintbrush	CASTI2	Castilleja
tapertip hawksbeard	CRAC2	Crepis acuminata
larkspur	DELPH	Delphinium
fleabane	ERIGE2	Erigeron
buckwheat	ERIOG	Eriogonum
aster	EUCEP2	Eucephalus
toadflax	LINAR	Linaria
granite prickly phlox, sagebrush gilia	LIPU11	Linanthus pungens
tufted evening-primrose	OECA10	Oenothera caespitosa
beardtongue, penstemon	PENST	Penstemon
phacelia	PHACE	Phacelia
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
scarlet globemallow	SPCO	Sphaeralcea coccinea
stemless mock goldenweed	STAC	Stenotus acaulis
clover	TRIFO	Trifolium
woodyaster	XYLOR	Xylorhiza
deathcamas	ZIGAD	Zigadenus
big sagebrush	ARTR2	Artemisia tridentata
shadscale saltbush	ATCO	Atriplex confertifolia

yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	CHVI8	Chrysothamnus viscidiflorus
rubber rabbitbrush	ERNA10	Ericameria nauseosa
spiny hopsage	GRSP	Grayia spinosa
winterfat	KRLA2	Krascheninnikovia lanata
spineless horsebrush, gray horsebrush	TECA2	Tetradymia canescens
shortspine horsebrush, spiny horsebrush	TESP2	Tetradymia spinosa

Site ID*:* R034AY140WY Ecological Site Description Vegetation List

(Red Lakes 8-1; Bull Moose 2)

Common name	Symbol	Scientific name
Indian ricegrass	ACHY	Achnatherum hymenoides
western wheatgrass	PASM	Pascopyrum smithii
basin wildrye	LECI4	Leymus cinereus
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
Grass, perennial	2GP	
inland saltgrass	DISP	Distichlis spicata
scratchgrass, alkali muhly	MUAS	Muhlenbergia asperifolia
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
Nuttall's alkaligrass	PUNU2	Puccinellia nuttalliana
alkali sacaton	SPAI	Sporobolus airoides
Forb, perennial	2FP	
milkvetch	ASTRA	Astragalus
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
scarlet globemallow	SPCO	Sphaeralcea coccinea
seepweed, alkali seepweed	SUAED	Suaeda
woodyaster	XYLOR	Xylorhiza
greasewood	SAVE4	Sarcobatus vermiculatus
fourwing saltbush	ATCA2	Atriplex canescens
winterfat	KRLA2	Krascheninnikovia lanata
bud sagebrush, bud sagewort	PIDE4	Picrothamnus desertorum

Site ID*:* R034AY162WY Ecological Site Description Vegetation List

(Mungo Federal 3-14)

Common name	Symbol	Scientific name
bluebunch wheatgrass	PSSP6	Pseudoroegneria spicata
Indian ricegrass	ACHY	Achnatherum hymenoides
needle and thread, needleandthread	HECO26	Hesperostipa comata
streambank wheatgrass, thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus
Grass, perennial	2GP	
Letterman's needlegrass	ACLE9	Achnatherum lettermanii
needleleaf sedge	CADU6	Carex duriuscula
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
prairie Junegrass	KOMA	Koeleria macrantha
saline wildrye, salina wildrye	LESA4	Leymus salinus
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
Forb, perennial	2FP	
common yarrow, western yarrow, yarrow	ACMI2	Achillea millefolium
rosy pussytoes, rose pussytoes	ANRO2	Antennaria rosea
milkvetch	ASTRA	Astragalus
Indian paintbrush, paintbrush	CASTI2	Castilleja
fleabane	ERIGE2	Erigeron
buckwheat	ERIOG	Eriogonum
aster	EUCEP2	Eucephalus
blue flax	LIPE2	Linum perenne
granite prickly phlox, sagebrush gilia	LIPU11	Linanthus pungens
desertparsley, biscuitroot	LOMAT	Lomatium
beardtongue, penstemon	PENST	Penstemon
phacelia	PHACE	Phacelia
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
stonecrop	SEDUM	Sedum
scarlet globemallow	SPCO	Sphaeralcea coccinea
stemless mock goldenweed	STAC	Stenotus acaulis
clover	TRIFO	Trifolium
winterfat	KRLA2	Krascheninnikovia lanata
little sagebrush, low sagebrush	ARAR8	Artemisia arbuscula
black sagebrush	ARNO4	Artemisia nova
birdfoot sagebrush	ARPE6	Artemisia pedatifida
big sagebrush	ARTR2	Artemisia tridentata
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	CHVI8	Chrysothamnus viscidiflorus

Site ID*:* R034AY322WY Ecological Site Description Vegetation List

(Red Lakes 10-7)

Common name	Symbol	Scientific name
western wheatgrass	PASM	Pascopyrum smithii
needle and thread, needleandthread	HECO26	Hesperostipa comata
bluebunch wheatgrass	PSSP6	Pseudoroegneria spicata
green needlegrass	NAVI4	Nassella viridula
muttongrass, mutton bluegrass	POFE	Poa fendleriana
Grass, perennial	2GP	
Bloomer's ricegrass	ACBL	Achnatherum ×bloomeri
Indian ricegrass	ACHY	Achnatherum hymenoides
blue grama	BOGR2	Bouteloua gracilis
needleleaf sedge	CADU6	Carex duriuscula
threadleaf sedge	CAFI	Carex filifolia
plains reedgrass	CAMO	Calamagrostis montanensis
squirreltail, bottlebrush squirreltail	ELEL5	Elymus elymoides
prairie Junegrass	KOMA	Koeleria macrantha
mountain muhly	MUMO	Muhlenbergia montana
Sandberg bluegrass	POCA	Poa canbyi(syn)
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda
Forb, perennial	2FP	
yarrow	ACHIL	Achillea
prairie sagewort, fringed sagewort	ARFR4	Artemisia frigida
larkspur	DELPH	Delphinium
beardtongue, penstemon	PENST	Penstemon
spiny phlox, Hood's phlox	PHHO	Phlox hoodii
scarlet globemallow	SPCO	Sphaeralcea coccinea
big sagebrush	ARTR2	Artemisia tridentata
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	CHVI8	Chrysothamnus viscidiflorus