0005

General.

From: Priscilla Burton
To: OGMCOAL
Date: 2/10/2009 10:33 AM
Subject: Fwd: Soils and Overburden guidelines
Place: OGMCOAL
Attachments: FinalSoilGuideJan2008.pdf

>>> Priscilla Burton Wednesday, January 28, 2009 2:59 PM >>>
See attached Soil Guide for Tables 3 & 7 .

Priscilla Burton, CPSSc
Division Oil Gas & Mining
319 Carbonville Rd., Ste. C
Price UT 84501
(435) 613-3733

State of Utah office hours are Mon. through Thurs.,
7 a.m. to 6 p.m.

GUIDELINES FOR MANAGEMENT of TOPSOIL and OVERBURDEN

1594 W. North Temple, Suite 1210
P.O. Box 14501
Salt Lake City, UT 84114-5801
(801) 538-5340

OGM Price Field Office
319 North Carbonville Rd., Suite C
Price, Utah 84501
(435) 613-3737

January 2008

TABLE OF CONTENTS

List of Tables

1. INTRODUCTION

R645-301-210

In accordance with the Utah Administrative Procedure Act (UAPA), these guidelines are advisory and give guidance for complying with the Utah Coal Mining and Reclamation Act of 1979. The Guidelines are based on established practices for the management of soils, substitute soils, waste rock or overburden.

Utah Division of Oil, Gas, and Mining (UDOGM) encourages research and development in land reclamation. Field trials should be used to develop site-specific vegetation regimes, better methods of soil profile reconstruction, proper fertilization rates, and improved soil and water conservation.

The objective of topsoil and overburden guidelines is to assist the applicant in formulating a management plan. These guidelines are developed according to the State of Utah regulations. Where appropriate, the Utah Coal Mining Rules have been cited. The State of Utah R645-Coal Mining Rules are available through a "Quick Reference, Mining Program" link on the DOGM home page, http://dogm.nr.state.ut.us/

The following main headings are covered in this document:

X Environmental Description, R645-301-220
X Operations Plan, R645-301-230
X Reclamation Plan, R645-301-240
X Bond Release, R645-301-880

2. Environmental Description

R645-301-220

A. Prime Farmland Determination

R645-301-221

Contact the National Resource Conservation Service (NRCS) to investigate the present and past farming activity within the permit area. The Utah NRCS homepage is found at: www.ut.nrcs.usda.gov Include the written NRCS evaluation for the surface disturbance areas.

R645-302-317.400 and R645-302-317.520 require that if prime farmland soils are identified, the topsoil and subsoil must be salvaged and replaced to a depth of four feet (to restore the productive capacity of the soil). All soil horizons must be segregated and stockpiled (R645-302-317.432). Each horizon stockpile must be clearly marked for proper soil replacement (R645-301-521.270). The soil must be replaced in the reverse order of stripping to help restore its former productivity (R645-302-317.540).

B. Soil Survey and Map

R645-301-222 and 223

The Division accepts three types of soil surveys as shown in the Table 1. An Order III survey provides a general overview of the permit area. It does not provide enough detail to plan soil salvage operations within the area of surface disturbance. Depending on the amount of surface disturbance acreage, an Order I or II soil survey is required for all areas to be disturbed (R645-301-222, R645-301-223, R645-302-314.100). The qualifications of the soil scientist conducting the survey must be qualified according to R645-301-130, and the soil scientist=s credentials may be reviewed by the Division. A certified, professional soil scientist can be located by state at http://www.agronomy.org/certification/directory

Table 1. Soil Survey Guide

MAP	USE	MAP SCALE	DETAIL[1]
Order III	Permit Area	1:20,000 to 1:63,360	Extensive. Soil boundaries are plotted by interpretation of remotely sensed data. Boundaries are verified by traversing representative areas and some transects. Minimum delineation size of 4 to 40 acres.
Order II	Surface Disturbance	1:12,000 to 1:31,680	Intensive. Each delineation is identified by field observations and remotely sensed data. Boundaries are verified at closely spaced intervals, and delineated soils are identified by traversing and in some map units by transecting. 1.5 to 10 acres minimum delineation size.
Order I	Surface Disturbance	1:15,840 or larger	Very Intensive. Soils in each delineation are identified by transecting and traversing. Soil boundaries are observed throughout their length. Remotely sensed data are used as an aid in boundary delineation with a minimum size of 2.5 acres or less.

[1]Adapted from USDA-NRCS, 1993. Handbook #18. Soil Survey Manual.

As required by R645-301-223 and R645-302-314.100, the soil survey must be conducted according to the methods, standards and procedures for soil surveys and mapping as described in Title 430-VI of the National Soils Handbook, (USDA-NRCS, 1993); USDA Handbook #18, Soil

Survey Manual (USDA-NRCS, 1993); and Keys to Soil Taxonomy, 8th ed. (Soil Survey Staff, 1998).

The surveys will describe the topography, elevation, and climate characteristics of the site as well as the observed and potential plant community, plant productivity, and land use (R645-301-222 *et seq*). This provides background information to be used in formulating the soils management plan for operations and reclamation.

Perform all soil surveys prior to ground disturbance (R645-301-211, R645-301-222, R645-301-232.600). Before initiating the Order I Soil Survey, consult the existing mine plan cultural and historic resource maps and/or contact the State History Preservation Office for information on historic sites within the soil survey area so that the soil survey is not destructive to these sites (R645-301-411.144).

The Order I and II surveys contain information collected from soil pits and supplemental auger holes arranged on transects throughout the site. From the soil pits, a description of the soil profile is made. Sample each profile and provide analytical results from collected samples (R645-301-223 and R645-302-314.100). (Soil analysis procedures are discussed in the following section.) Use the information obtained during the survey to create a soils map of the site on a scale of 1:15,000 or larger (R645-301-222.100 and R645-302-314.100).

Within the Order I or II survey (R645-301-222.100 and R645-302-314.100):

Provide a soil survey map at 1:15,000 (1 in = 1,250 ft) scale or larger (R645-301-141) with:

- Sample sites identified.
- The extent of each soil type outlined.
- Inclusions[1] within the soil type which are either more limiting or beneficial for reclamation shown.
- The percentage area of inclusions within each soil map unit.
- If the same scale (1:15,000) is used for the proposed surface facilities map (R645-301-141 and R645-301-521.161), it can be easily overlaid onto the soil survey map for planning purposes. .
- Preparation of a soil salvage map, outlining each soil type, soil salvage area, salvage acreage and salvage depth can be used to help describe the methods for removing topsoil and subsoil (R645-301-231.100). In addition, a salvage map will enable field personnel to readily identify soil salvage areas without having to stop and read the soil survey in the Mining and Reclamation Plan.

C. Soil Characterization

R645-301-222, 223, 224

[1] **Inclusions**: soils that are not described by the soil map unit name and that cannot be used for the same purposes as the surrounding soils. They could be separately delineated if the map scale permits it. Areas too small to delineate may be identified and located on the map by special symbols.

The procedures outlined in this section are taken directly from the National Cooperative Soil Survey which is incorporated in the R645 Rules by reference R645-301-223 and R645-301-314.100.

Locate and evaluate each soil pit and/or auger location to thoroughly represent each mapping unit and to characterize the parent material, vegetative communities, slope and aspect. The number of sampling sites depends largely on the variability of the soils at the site and the extent of each soil map unit. At a minimum, represent each soil type with at least one soil pit location. Auger locations are used along transects from the soil pit to further delineate each soil type. Sample and report each inclusion separately.

At the time of sampling, characterize each location for physical and chemical parameters according to Table 2 and following the protocol of the Field Book for Describing and Sampling Soils, USDA-NRCS, 1998. Sample by soil horizon and report the depth interval. Where no horizons are evident, sample every 6 inches (15 cm) or less for the first 12 inches (30 cm) of the soil profile and at 24-inch (60 cm) depth intervals thereafter, down to 72 inches (180 cm) or to bedrock, whichever comes first. Record the location and the depth for each individual soil sample.

Conduct the laboratory analyses listed in Table 3 for each increment sampled. Encourage the laboratory to use the recommended methods to enable comparison between samples and locations. The field parameters along with laboratory analyses of pH, Saturation Percent, Electrical Conductivity, Sodium Adsorption Ratio, Particle Size Analysis, Available Water Capacity, K-factor, and $\%CaCO_3$ will be used to establish the soil type and evaluate the suitability of soil and overburden for salvage and use in reclamation (see Table 4).

Replacement depths of topsoil may vary over the site with the objective of establishing a diverse plant population. However, Utah regulations specify that four feet of cover is required over any toxic or acid-forming materials (R645-301-528.350 and R645-301-553.250; R645-301-553.300 and R645-301-731.300 *et seq*).

Table 2. Field Parameters For Baseline Soil Characterization

Test to be Performed	Reported As	Suggested Methods
Texture	% sand, silt, clay	U.S. Department of Agriculture, Natural Resource Conservation Service, 1998. Field Book for Describing and Sampling Soils, Version 1.1. p 2-28 -2-31.
Structure/Consistence	grade, size, type	Ibid. p 2-38 through 2-51.
Visual Estimate % Coal	% area & size fragments	Ibid. p 2-20, 2-26, 7-1, 2-29, and 2-37.
Internal Rock	% volume & size fragments	Ibid. p2-32 through 2-37 and p2-20 and p 2-26.
Surface Rock	% cover & size fragments	Ibid. loc cit.
Soil Color	Hue Value/Chroma	Ibid. p 2-7 through 2-15.
Bulk Density	g/cm^3	Soil Science Society of America. 1986. Series No. 5. Methods of Soil Analysis: **Part 1** - Physical and Mineralogical Methods. Chapter 13. p 367. Excavation Method.
Chemical Response	pH	U.S. Department of Agriculture, Natural Resource Conservation Service, 1998. Field Book for Describing and Sampling Soils, Version 1.1. p 2-64.
	EC	Ibid. p 2-66.
	Effervescence	Ibid. p 2-65.
	Gypsum	U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Handbook 60. Method 22a. p102.

Table 3. Analytical Methods For Baseline Soil Characterization

Test to be Performed	Reported As	Suggested Methods[1]
pH	saturated paste standard units	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis: **Part 3** - Chemical Methods. Chapter 14, page 420 and Chapter 16, page 487.
Saturation %	%	USDA-NRCS.1996. Soil Survey Laboratory Methods Manual.(SSIR No 42) ver. 3.0, Method 8A, page 402.
EC_e	dS/m @ 25°C (or mmhos/cm)	Ibid. Chapter 14, pp 420 - 422 and pp 427 - 431.
Soluble Na, K, Mg, Ca	meq/L	Ibid. Chapters 14 pp 420-422 (saturation extract);Chapter 19 pp 555-557; Chapter 20 pp586-590 (spectroscopic methods).
Available NO_3-N	mg/Kg	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis: **Part 3** - Chemical Methods. Chapter 38. p 1129 (KCl extraction). For analysis follow: Sims, J.R. and G.D. Jackson. 1971. Rapid Analysis of Soil Nitrate with Chromotropic Acid. Soil Sci. Soc. Am. Proc. 35-603-606.
Available Phosphorus	mg/Kg	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis: **Part 3** - Chemical Methods. Chapter 32, page 895. ($NaHCO_3$ Extraction.)
Particle Size Analysis	% very fine sand, sand, silt, clay	Soil Science Society of America. 1986. Series No. 5. Methods of Soil Analysis: **Part 1** - Physical and Mineralogical Methods. Chapter 15 pp 398 and 404-409 (Hydrometer Method).
Organic Matter	%	Western States Laboratory Proficiency Testing Program Soil and Plant Analytical Methods. 1998. v 4.10. p 86. (Loss on Ignition, convert %LOI to OM by regression intercept value as noted in method)
$CaCO_3$ %	%	Ibid. p. 99 (Soil Carbonates, Gravimetric Determination after extraction with 3 M HCl.) Total Inorganic Carbon = $\%CaCO_3$ x 0.12.
Extractable Potassium	meq/100 g^{-1}	Western States Laboratory Proficiency Testing Program Soil and Plant Analytical Methods. 1998. v 4.10. p 73

[1] Laboratories vary in their capabilities. Specify these recommended methods to the laboratory. Use of other methods should be discussed with the Division.

Table 4. Soil Suitability/Unsuitability Evaluation

CRITERIA	GOOD	FAIR	POOR	UNACCEPTABLE
Saturation %	25 to 55	≥56 - 80	<25 >80	
pH	6.5 to 8.2	6.0 to 6.4 8.2 to 8.5	5.5 to 6.0 8.6 to 9.0	< 5.5 > 9.0
EC (mS/cm 25°C)	0 to 4	4 to 8	8 to 15	> 15
SAR [a,b]	0 to 4	5 to 10	10 to 14	> 14 [a]
$\%CaCO_3$	<15	15 - 30	>30	
Texture [c]	sl, l, sil, scl, vfsl, fsl	cl, c, sicl, sc, ls, lfs	sic, s, sc, c, cos, fs, vfs	g, vcos
Total Organic Carbon	<10%			∃10%
Available Water Capacity[d]	> 0.10 moderate	0.05 to 0.10 low	< 0.05 very low	
K factor[e]	< 0.37	0.37	> 0.37	

[a] For clay textured soils unacceptable is SAR >14. For sandy textured soils unacceptable is >20.

[b] For most Western soils, the SAR to ESP relationship is usually 1:1, up to ESP . 20. If SAR>20, then determine ESP. (Evangelou, 2000.)

[c] s=sand, l= loam, si= silt, c= clay, v= very, f= fine, co=coarse, g=gravel

[d] Available Water Capacity is adjusted for texture and SAR.

[e] K factor recommendations from the USDA Soil Conservation Service.1978. National Soils Handbook Notice 24. (3/31/78). NSH Part II B403.6(a). For Prime Farmland soils, the K factor times the percent slope should be a value of five or less for minimal erosion hazard.

1. Saturated Paste Methods

To obtain a sample of the soil solution for salinity analyses, the laboratory will make a saturated paste. The least amount of water possible should be added to the soil sample to enable comparison between salinity measurement and actual soil conditions. Over dilution of the soil sample misrepresents field conditions, because the dissolution of salts is relative to the amount of water in the extract. The saturated paste method (Rhoades, 1996) is the preferred method for obtaining soil solution extracts. The saturated paste method (see Table 3) is preferable, but not always practical when clay soils are being analyzed. The soil:water ratio used for extraction should always be reported.

The saturated paste extract is used for laboratory analysis and calculation of the following parameters:

a) pH
b) Saturation Percent
c) Electrical Conductivity
d) Sodium Adsorption Ratio
e) Exchangeable Sodium Percentage

a. pH

The pH is the negative logarithm to base 10 of the hydrogen ion activity and therefore indicates the acidic or basic condition of the soil (pH of 7 is neutral; pH below 7 is acidic; pH above 7 is basic). The pH measurement is valuable as an indicator of the availability of plant nutrients and the presence of particular ions in the soil solution. For example, a pH of 8.3 or less indicates that calcium is abundant in the soil solution, whereas above pH 8.5, the sodium ion dominates the soil solution. Values of pH 5.0 to 5.5 could indicate soluble, toxic levels of Al^{3+} and Mn^{2+}. Extreme conditions, such as pH below 3.0, indicate the presence of metal sulfides.

In calcareous soils, the major factor determining pH is the carbonate to bicarbonate (CO_3^{3} : $HCO_3^{!}$) ratio as affected by the partial pressure of carbon dioxide (Thomas, 1996). This ratio also has importance in the evaluation of the sodium adsorption ratio (Ayers and Westcot, 1985).

Standard methods for measuring soil pH include saturated paste or 1:1 (soil:water) extract.

b. Saturation Percentage

Saturation percent (SP) is commonly determined by drying a subsample of the saturated paste (Dudley, 2000). (A subsample is used, because oven-dried samples can not be used for further extraction and analysis, since heating converts gypsum to plaster of Paris and the latter salt has a higher solubility in water.) The weight of the subsample of saturated soil is recorded and then the soil is oven-dried. The oven-dry soil weight is recorded. The SP is calculated by