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State of Utah

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August 7, 1995

TO: FILE

TO: Daron Haddock, Permit Supervisor

FROM: Henry Sauer, Senior Reclamation Soils Specialist

RE: Substitute Topsoil Material Sampling- Sowbelly Canyon, ~~AMAX Coal~~ Co., Castle Gate Mine, ACT/007/004, Folder #2, Carbon County, Utah

SYNOPSIS

EarthFax Engineering Inc.(EFE), representing the permittee, and this writer collected soil samples and physically described surficial material (substitute topsoil material) in Sowbelly Canyon. The purpose of the sampling plan was to characterize the substitute topsoil materials within the regrade disturbed area and to identify soil factors which may limit plant establishment.

The forthcoming analysis is a preliminary interpretation of the soils profile information collected. When results of laboratory analysis are received additional analysis, discussions and recommendations will be forthcoming.

ANALYSIS

On June 27, 1995 Mr. David McMillan (EFE) and this writer physically described six soil profiles within the disturbed and regraded area in Sowbelly Canyon. Coal waste samples and substitute topsoil samples were collected as described by EFE sampling plan dated June 19, 1995 and this writers memo to Daron Haddock dated June 22, 1995.

Sampling Methods:

Soil profile description (see attachment) were performed using methods outlined in U.S.D.A./Natural Resource Conservation Service Keys to Soil Taxonomy. Soil color and texture were estimated based on ambient soil moisture content. A pocket penetrometer (Model CL-700, SoilTest, Inc., Evanston Ill.) was used to measure the unconfined compressive strength in tons/ft^2. Penetrometers are used to provide a relative measure of the resistance offered by soil to the penetration of roots (Soil Physics, Marshall and Holmes, 1979).

Two separate samples of inplace natural soil aggregates were collected from the following locations and depth increments: SB-1: 0-10 inches and SB-2: 0-12 inches. Field soil bulk density (D_b) was determined as described in C.A. Black (ed.) Methods of Soil Analysis Part I (1965), American Society of Agronomy, Method 30-4, pages 381-383. It must be noted that soil grade for the D_b samples were strong. Therefore protective Saran coating of the natural clods was not encorporated into the sample preparation. D_b determination by the Eley Volumeter method was performed on sample SB-2:36-38 inches.

Sample Result:

Profile	Depth	Structure #	UCS *	D_b**	D_b***
SB-1	0-5"	S-MSB	>4.5	1.62	-
SB-1	5-21"	M-SFSB	>4.5	-	-
SB-1	21-50"	W-MSB	2.7	-	-
SB-2	0-36"	SCSB	>4.5	1.75	-
SB-2	36-??"	VWFSB-G	>4.5	-	1.5
SB-3	0-37"	MSBC	>4.5	-	-
SB-3	37-??"	WFSB-G	>4.5	-	-
SB-4	0-5"	WMSB	1.7	-	-
SB-4	5-16"	MMSB	3.5	-	-
SB-4	16-30"	Massive	1.75	-	-
SB-4	30-46"	Massive	0.5	-	-
SB-4	46-54"	Granular	>4.5	-	-
SB-4	54-60"	Granular	3.0	-	-
SB-6	0-24"	WMSB	-	-	-
SB-6	24-26"	VWFSB-G	-	-	-
SB-6	26-30"	WMSB	-	-	-
SB-6	30-120"	MSB	-	-	-
SB-7	0-32"	WFSB	2.5	-	-
SB-7	32-62"	VWMSB	0.3	-	-
SB-7	62-??"	Massive	3.2	-	-

 # - Structure:

Grade	Size	Type
W-Weak	VF-Very Fine	PL-Platy

M-Moderate	**F-Fine**	**GR-Granular**
S- Strong	**M-Medium**	**SB-Subangular Blocky**
	CO-Coarse	**M-Massive**
	VCO-Very Coarse	

*** UCS - Unconfined compressive strength in tons/ft.^{2}**
**** D_b - Bulk Density (g/cc) by Methods of Soil Analysis Part I**
***** D_b - Bulk Density (g/cc) by Eley Volumeter**

Discussion:

Compaction occurring with soil replacement and/or soil preparation creates soil densities that are sufficient to physically restrict root growth, and reduce the availability of water used by plant species (Yeck et.al. 1983). When soil aggregates are compressed beyond the plastic limit pore space between soil particles is reduced and soil bulk density (D_b) is increased. Soil compaction severely reduces the hydraulic conductivity of the soil (Davis, Dexter and Tanner, 1973). This inturn enhances run-off, concentrated flow and ultimately soil erosion. Soil compaction alters the soils capacity to hold plant available water and oxygen supply to plant roots (Proceedings of the Soil Quality Standards Symposium page 52-61, San Antonio, Texas, October, 1990). Indirectly, soil compaction may reduce plant production by denying root access to nutrients. Generally an inverse relationship between rate of root elongation and soil resistance to penetration exists (Taylor and Ratliff, 1969). Current literature often uses bulk densities of 1.6 to 1.7 g/cc as a range in which root penetration is significantly inhibited however some investigators estimate that inhibition can begin below a bulk density of 1.5 g/cc (Trouse 1977).

Soil profiles SB-1 thru SB-3 are highly compacted. As a result plant available water in the soil profile will be extremely limiting. This may inhibit the sites potential for meeting revegetation standards. Current plant growth in the vicinity of SB-1 thru SB-3 may be attributable to the unusually wet growing season of 1995 and recent application of inorganic fertilizer. However, select plant species may have adapted to the poor soil conditions and responded positively.

RECOMMENDATIONS

To determine the validity of the aforementioned statements and demonstrate compliance with R645-301-240 et.seq, the permittee must conducted additional quantitative vegetation monitoring (canopy cover) in the next two growing seasons (e.g. 1996 and 1997).

CC:Paul Baker

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

SOIL DESCRIPTION

U.S. DEPARTMENT OF AGRICULTU
SOIL CONSERVATION SERVICE

Soil type

File No

Area Sowbelly Canyon | Date 6/27/95 | Stop No.

Classification

Location SBRD-4/SB-4

N. veg. (or crop) | Climate

Parent material Shale/Sandstone/Coal

Physiography Canyon fill

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope 0-1% | Moisture

Aspect SEast | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes Culvert in backfill

Vegetation (Grass) and root systems covered with coal waste + slightly altered mancos shale

* Control section average

Horizon	Depth	Color		Texture	GRADE/SIZE TYPE Structure	Consistence			Reaction	BOUNDARY	Penetration			
		Dry	Moist			Dry	Moist	Wet						
	0-32"			SL	WFSB				+++	Wavy	2.50	Coal Soil	Coal Mancos	Contaminated shale
	32"-62"			F Sandy Loam	V Weak MSB				+++	Distinct Clear	0.30			
	62"-?			Clay Loam	Massive				+++	Wavy	3.20			

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SOIL DESCRIPTION

U.S. DEPARTMENT OF AGRICULTU
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Soil type | File No
Area Sowbelly Canyon | Date 6/27/85 | Stop No.
Classification SB-6
Location SBRD-4
N. veg. (or crop) | Climate
Parent material Shale, sandstone
Physiography
Relief | Drainage | Salt or alkali
Elevation | Gr. water | Stoniness
Slope 0-1% Slope Break | Moisture
Aspect | Root distrib. | % Clay *
Erosion | % Coarse fragments * | % Coarser than V.F.S. *
Permeability
Additional notes
Mouth of canyon immediately before slope break

* Control section average

Horizon	Depth	Color		Texture	GRADE/SIZE TYPE Structure	Consistence			Reaction	BOUNDARY				
		Dry	Moist			Dry	Moist	Wet						
	0-24"	10YR 4/2			WMSB				+	Distinct				
	24-26"	2.5Y 5/4			VWFSB Granular				+++	"	Road base			
	26-30"	10YR 2/1			WMSB				++	"	Slightly weathered shale			
	30"-120"	10 YR 5/3			MSB				+++	"				

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SOIL DESCRIPTION

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Soil type

File No

Area Sowbelly | Date | Stop No.

Classification

Location SB-4

N. veg. (or crop) | Climate

Parent material Shale Coal

Physiography Graded Slope

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope 18-20% | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes

* Control section average

Horizon	Depth	Color		Texture	GRADE/SIZE TYPE Structure	Consistence			Reaction	BOUNDARY	[illegible]	Db		
		Dry	Moist			Dry	Moist	Wet						
	0-5"		10Y 3/2	Silty loam	WM SB				###	Distinct	1.7			
	5"-16"		10Y 3/2	Silty CL	Mod MSB				##	Distinct	3.5			
	16"-30"		7.5YR 2/0	Silty CL	Massive				##	Distinct	1.75			
	30"-46"		7.5YR 2/0	Coal	Massive				0	Distinct	0.5			
	46"-54"		2.5Y 5/4	Shale	Granular				##	Distinct	>4.5			
	54-60"			Sand	Granular				##		3.0			

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SOIL DESCRIPTION

Soil type | File No

Area Sowbelly Canyon | Date 6/27/95 | Stop No.

Classification

Location SB-3

N. veg. (or crop) | Climate

Parent material SHALE Sandstone

Physiography

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope 3-10% | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes

* Control section average

Horizon	Depth	Color		Texture	GRADE/SIZE TYPE Structure	Consistence			Reaction	BOUNDARY	Penetrometer			
		Dry	Moist			Dry	Moist	Wet						
	0-37			Silty Clay Loam	Med/Coarse Sub Blocky				+++		>4.5	Slight cementation change @ 10"		
	37-??			Sandy loam	Granular WFSB				+++		>4.5			

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SOIL DESCRIPTION

Soil type | File No

Area Sowbelly Canyon		Date 6/27/95	Stop No.
Classification			
Location SB-2			
N. veg. (or crop)		Climate	
Parent material Shale			
Physiography			
Relief	Drainage	Salt or alkali	
Elevation	Gr. water	Stoniness	
Slope	Moisture		
Aspect	Root distrib.	% Clay *	
Erosion	% Coarse fragments *	% Coarser than V.F.S. *	
Permeability			

Additional notes

0-12" Sampled for Dg by existing clods
36"-38" " " " by Ely Volumeter

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Grade/Size Type Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	Penetration		
	0-36"			Silt loam	Strong Coarse SB				#		>4.5		
	36"-73			Loam	Granular to VWESB				#.5		>4.5		

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SOIL DESCRIPTION

U.S. DEPARTMENT OF AGRICULTU
SOIL CONSERVATION SERVICE

Soil type | File No

Area Sowbelly Canyon | Date 6/27/75 | Stop No.

Classification

Location SB-1

N. veg. (or crop) | Climate

Parent material shale

Physiography

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope 15% | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

Permeability

Additional notes

0-5 Root action and freeze thaw decrease cementation
Compact layers @ 5"-21"

* Control section average

Horizon	Depth	Color		Texture	GRADE/SIZE TYPE Structure	Consistence			Reaction	BOUNDARY	Penetrometer		
		Dry	Moist			Dry	Moist	Wet					
	0-5"			Silt Loam	Strong Med SB					###	>4.5		
	5"-21"			Silt Loam	Massive Strong Fine SB					##	>4.5		
	21"-50"+			Sandy Clay Loam	Weak Med SB					###	2.7		