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DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

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October 25, 1991

TO: File

FROM: Henry Sauer, Senior Reclamation Soils Specialist

RE: Test Plot Treatment Proposal, PacifiCorp Electric Operations, Des-Bee-Dove Mine, ACT/015/017, Folder #2, Emery County, Utah

Synopsis

As a means of demonstrating the reclaimability of the Des-Bee-Dove Haul Road fill between stations 131+00 and 142+00 (Permit Application Package, Plate 5-5), the permittee has proposed to conduct field site trials (test plots). The following analysis is a brief overview which summarizes physiochemical characteristics of the proposed plant growth medium, the plant growth limiting factors, the treatment methodologies proposed and a brief explanation of the theoretical basis for the treatments.

For the sake of convenience, the fill material proposed as plant growth medium for final reclamation will be designated as 'topsoil.'

Analysis

Environment

The 'topsoil' is side cast fill (slope $\triangle$ angle = 50% - 65%) placed subsequent to haul road construction. Slope aspect ranges from south to southeast. Precipitation at higher elevations on the plateau (approximately 10,000 feet above sea level) averages 15 inches per year. The majority of which is winter precipitation in the form of snow. The Haul Road and environs are on the rain shadow, eastern side of the Wasatch Plateau and at an elevation of approximately 7,000 feet. Therefore, precipitation is substantially less than on top of the Plateau and "effective precipitation" is estimated at approximately 4 to 5 inches per year.

Physiochemical Characteristics

The 'topsoil' is slightly altered Mancos Shale. The soils on undisturbed Mancos fillslopes are classified as Loamy Skeletal, Shallow Lithic Ustorthents. The

geological unit is a pelitic cretaceous aged marine shale, with a high percentage (i.e., between 40 and 60 percent) of mixed-layered illite-smectite clay. Carbonate content ranges between 4 and 15 percent. Soluble mineral salts composed of the cations sodium, calcium and magnesium, and the anions chloride and sulfate dominate the soil solution which results in elevated electrical conductivities. Soil dispersion is caused by sodium ion dominated exchange sites and swelling of clay which deteriorate soil structure and reduce the availability of other essential elements (laboratory analyses, see attachments). Additional soil analysis will be conducted prior to test plot implementation to ascertain amendment and fertilization requirements.

Limiting Factors

One of the major limiting factors of this 'topsoil' to plant growth is poor physical structure which reduces aeration, water infiltration, and permeability and increases surface crusting, compaction, surface runoff, erosion, and upward salt migration.

Another major limiting factor is sufficient soluble salts in the soil to interfere with the growth of desirable vegetation by reducing the availability of soil water to plants.

Other limiting factors are severe slope angles, long uninterrupted slope length, high evapotranspiration potential and low annual precipitation.

Proposed Treatments and Theoretical Basis

Lands disturbed by coal mining activities where Mancos Shale has been disturbed are difficult to reclaim because of the adverse physiochemical properties of the spoil/soil material and the arid/semiarid climate of the area. Reclamation of Mancos Shale has met with limited success. Therefore, spoil/soil modifications are essential for successful revegetation of these sodic, saline, high clay content material.

As one means of amending these materials, the Division is proposing the use of sulfuric acid (H_2SO_4) in combination with incorporated organic amendments (i.e., woodchips and hay). It is estimated that these treatments should result in short term (organic amendments) and long term (inorganic amendments) improvement of the 'topsoil' physical characteristics through the replacement and leaching of sodium under natural precipitation conditions.

The function of H_2SO_4 is to solubilize natural alkaline earth carbonates (i.e., $CaCO_3$) inherently present in the 'topsoil' and produce gypsum according to the following reaction:

$$H_2SO_4 + CaCO_3 \leftrightarrow CaSO_4 + CO_2 \text{ (gas)} + H_2O$$

Gypsum then disassociates so that calcium can displace sodium from the cation exchanges capacity (X) by the following reactions:

$$2\ Na\ X + Ca^{++} + SO_4^{-2} \leftrightarrow Ca\ X + NaSO_4$$

As a secondary and/or primary effect, the H_2SO_4 may solubilize aluminum and iron from silicate clay minerals. Both Al^{+3} and $Al(OH)^{+2}$ serve to displace Na^+ from the cation exchange sites, which caused a decreased sodium absorption ration.

The effects of inorganic amendments, especially in this arid/semiarid environment, will not be immediate. Therefore, organic amendments must be employed to stabilize and protect the 'topsoil' and temporarily mitigate the poor physical conditions of the 'topsoil.'

Amendment application rates are tentative at this time. Additional soil analysis will be required and possibly column leach studies to determine H_2SO_4 purity and application feasibility and affect on exchange complex.

H_2SO_4 amendment recommendations will be based on the following:

1) Initial Exchangeable Sodium Percent (ESP) → Desired ESP
2) Cation Exchange Capacity
3) Elemental Concentration of H_2SO_4 and solubility
4) Incomplete Exchanges Reaction Factor ≈ 1.25
5) Sulfur equivalent to replace Na/100g soil ≈ 0.32 Tons S/Acre-Foot/1meq Na
6) Plot Size
7) Column Study

jbe
cc: Pamela Grubaugh-Littig
AT015017.TPT

BIBLIOGRAPHY

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Schuman, Gerald E., Ernest M. Taylor, Jr., James L. Meining, and Scott E. Belden, Role of Organic and Inorganic Amendments in Reclaiming Bentonite Spoils, Proceedings: Symposium on Evolution of Abandoned Mine Land Technologies, Riverton, Wyoming, June 1989

United States Department of Agriculture, Diagnosis and Improvement of Saline and Alkali Soils, Agriculture Handbook No. 60, February 1954

Williams, R. Dean, and Gerald E. Schuman, Reclaiming mine soils and overburden in the western United States, Analytic parameters and procedures, Soil Conservation Society of America, 1987

DEB-BEE-DOVE HAUL ROAD

APRIL 1,1985

FOR:
UTAH POWER & LIGHT CO.
MINING & EXPLORATION DEPT.
BOI 899
SALT LAKE CITY, UT 84110

ATTEN: MR. CHRIS SHINGLETON

BY:
NPI SOIL TESTING/PLANT TISSUE
ANALYSIS LABORATORY
417 WAKARA WAY
SALT LAKE CITY , UT 84108

VON ISAMAN (801) 582-0144 EXT. 371

SAMPLE No.	pH	EC mmhos/cm	Sand (%)	Silt (%)	Clay (%)	Texture Class *	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR
1 DH 2	8.12	9.5	35.28	26.72	38	CL	22	15	121	26
1 DH 4	7.82	9.98	22	34.56	43.44	C	22	19	127	28
1 DH 6	8.21	10.58	37.28	28	34.72	CL	30	28	162	30
1 DH 8	8.08	7.58	39.28	30.72	30	CL	28	33	71	13
1 DH 10	8.08	8.55	30	28.56	41.44	C	24	22	103	21
1 DH 12	8.01	10.79	43.28	26.72	30	CL	24	15	151	34
1 DH 14	7.82	10.14	45.28	25.28	29.44	SCL	23	18	139	31
1 DH 16	8.17	8.78	30	31.28	38.72	CL	28	37	104	18
1 DH 18	7.87	8.03	41.28	26.72	32	CL	24	20	81	17
1 DH 20	7.72	8.68	47.28	24	28.72	SCL	27	22	95	19
1 DH 22	7.78	7.68	47.28	22.72	30	SCL	25	23	67	14
1 DH 24	7.98	7.29	49.28	22.72	28	SCL	27	22	68	14
1 DH 26	7.78	8.12	51.28	22.72	26	SCL	26	22	75	15
1 DH 28	8.05	7.14	47.44	19.84	32.72	SCL	32	27	72	13
1 DH 30	7.72	8.18	55.28	16.72	28	SCL	24	24	74	15
2 DH 2	7.88	9.02	39.28	30	30.72	CL	23	18	113	25
2 DH 4	7.86	10.36	47.28	23.28	29.44	SCL	22	13	126	30
2 DH 6	8.19	9.62	51.28	23.28	25.44	SCL	24	10	131	32
2 DH 8	8.01	10.03	49.28	25.28	25.44	SCL	22	9	157	40
2 DH 10	7.66	9.84	48.16	23.84	28	SCL	39	32	132	22
2 DH 12	8.02	10.05	39.44	25.84	34.72	CL	30	42	127	21
2 DH 14	8.03	10.81	37.28	30	32.72	CL	23	20	142	30
2 DH 16	8.08	10.64	43.76	24.96	31.28	CL	23	19	140	30
2 DH 18	8.02	10.61	45.76	20.96	33.28	SCL	22	18	136	30
2 DH 20	7.98	9.44	45.44	24.56	30	SCL	26	51	123	20
2 DH 22	7.97	8.95	48.88	21.12	30	SCL	35	48	112	17
2 DH 24	8.01	9.36	53.76	17.68	28.56	SCL	23	16	124	28
2 DH 26	7.81	9.61	52.48	21.68	25.84	SCL	23	17	117	26
2 DH 28	8.05	10.03	50.48	20.96	28.56	SCL	22	15	131	30
2 DH 30	7.81	9.52	50.48	21.68	27.84	SCL	24	15	128	29
2 DH 32	7.83	10.24	52.48	21.68	25.84	SCL	23	14	128	30
2 DH 34	7.89	10.45	56.48	21.68	21.84	SCL	24	16	139	31
2 DH 36	7.86	10.78	58.48	19.68	21.84	SCL	24	16	134	30
2 DH 38	7.98	9.23	38.88	29.12	32	CL	28	17	141	30

*C =CLAY CL=CLAY LOAM L=LOAM LS=LOAMY SAND S= SAND SC=SANDY CLAY SCL=SANDY CLAY LOAM SL=SANDY LOAM
SI=SILT SIC=SILTY CLAY SICL=SILTY CLAY LOAM SIL=SILTY LOAM

SAMPLE No.	pH	EC mmhos/cm	Sand (%)	Silt (%)	Clay (%)	Texture Class *	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR
3 DH 2	8.13	4.36	47.44	30.56	22	L	26	34	28	5
3 DH 4	8.12	5.73	45.44	32.56	22	L	35	21	28	5
3 DH 6	8.18	5.62	55.2	26.96	17.84	SL	30	30	27	5
3 DH 8	8.24	6.92	49.44	25.84	24.72	SCL	26	49	37	6
3 DH 10	8.04	6.74	57.2	22.96	19.84	SL	26	34	34	6
3 DH 12	8.07	5.89	55.2	24.96	19.84	SL	28	30	32	6
3 DH 14	8.02	5.63	57.2	22.96	19.84	SL	26	30	30	6
3 DH 16	8.01	5.36	56.48	22.96	20.56	SCL	28	28	28	5
4 DH 2	8.85	2.61	59.28	23.28	17.44	SL	3	33	24	6
4 DH 4	8.14	9.21	53.44	25.84	20.72	SCL	22	17	63	14
4 DH 6	8.06	9.13	49.44	27.12	23.44	SCL	45	41	44	7
4 DH 8	8.15	6.01	47.44	29.84	22.72	L	28	35	24	4
4 DH 10	8.28	6.37	60	22	18	SL	26	30	38	7
4 DH 12	8.16	6.17	48	28	24	SCL	27	32	34	6
4 DH 14	8.22	6.21	50.72	26	23.28	SCL	41	33	33	5
4 DH 16	8.04	5.92	46.88	28.56	24.56	L	27	33	31	6

*C =CLAY CL=CLAY LOAM L=LOAM LS=LOAMY SAND S= SAND SC=SANDY CLAY SCL=SANDY CLAY LOAM SL=SANDY LOAM
SI=SILT SIC=SILTY CLAY SICL=SILTY CLAY LOAM SIL=SILTY LOAM

Client : Utah Power & Light Co. -Mining Div.
Address : P.O. Box 310
Huntington, UT 84528
Attn. : Val Payne
Project : JS314734

Sample Matrix: Soil
Sample ID: SS4A
Sample Date Time: Unknown

Lab No. : 90-SI/00211
Date Received: 03/16/90

Parameters

Saturation %	46.	%	
pH, saturated paste	8.3	units	1
Conductivity, sat. paste	22.00	mmhos/cm	1
Calcium, soluble	17.3	meq/l	1
Magnesium, soluble	232.8	meq/l	1
Sodium, soluble	257.5	meq/l	1
Potassium, soluble	1.6	meq/l	1
Sodium Absorption Ratio	23.0		
Nitrogen, total Kjeldahl	.04	%	
Nitrate as N, soluble	17.3	mg/kg	6
Phosphorus, extractable	-1	mg/kg	3
Organic Matter	1.6	%	
Boron, soluble	1.1	mg/kg	2
Selenium, soluble	.5	mg/kg	2
Sulfur, total	.81	%	
Neutralization Potential	9.3	% as CaCO3	
Acid-Base Potent (CaCO3)	68	Tons/1000T	
Coarse Fragments > 2mm	55.3	%	
Sand	30.	%	
Silt	55.	%	
Clay	15.	%	
Texture	SIL		

Remarks:

1 Saturated Paste Extraction
3 AB-DTPA Extraction
6 Water Extraction
7 Potassium Chloride Extraction

Note: Negative sign "-" denotes that the value is less than "<"

Frank E. Polniak, Inorganic Lab Supervisor

Frank E. Polniak

FGL

FRUIT GROWERS LABORATORY, INC.

May 19 ,1989

LAB NO:15913 03

RE: LANDSCAPE SOIL ANALYSIS

Nature-Gro Corp.
P.O. Box 4135
Pacoima, CA 91381

Location: Utah P & E, below road
Description:Preplant Landscape
Date Sampled: 05/04/89
Sampled by: Nature-Gro

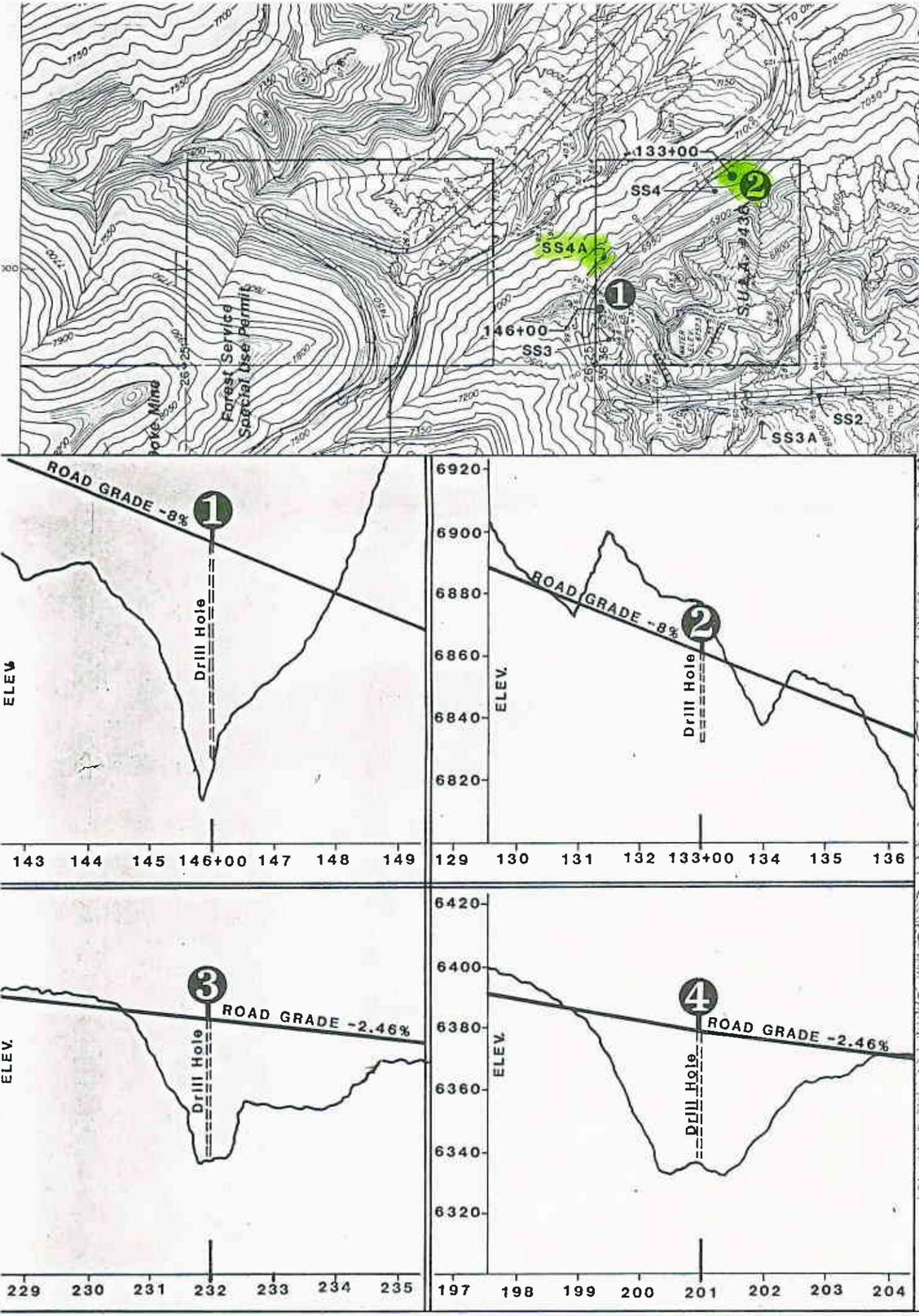
Date Received: 04/27/89
Depth: 0-6"

EST RESULTS est Description	Your Analysis		Optimum Range	Comment
oisture	1.00	%	1/2 Satn. %	Too Dry
aturation	32.00	%	--	Loam
itrate-Nitrogen	6.00	PPM	10 - 40	Low
hosphorus	2.00	PPM	13 - 40	Very Low
Exch. Potassium	270.00	PPM	81 - 300	Ample
Limestone	7.30	%	0	See Below*
pH	7.90		5.8 - 8.2	OK
Soil Salinity	20.70		0.3 - 2.0	Excessive
Gypsum Requirement	4.00	T/AF	0	Apply
Lime Requirement	0.00	T/AF	0	OK
Sulfate-Sulfur	95.80	meq/l	< 20	Excessive
Chloride	39.00	meq/l	<3	Excessive
Boron	0.50	PPM	0.02 - 1.0	OK
Calcium	49.30	meq/l	>2.0	Ample
Magnesium	16.30	meq/l	>1.5	Ample
Sodium	175.80	meq/l	See SAR/ESP	--
SAR	30.70		<7	Too High
ESP	30.30		<10	Too High
Zinc	2.40	PPM	> 0.7	Ample
Manganese	1.60	PPM	>1.4	Ample
Iron	16.90	PPM	>8	Ample
Copper	0.80	PPM	>0.2	Ample

Soil pH & Limestone levels are important to consider when making plant selections. Soils having pH levels above 7.0 should not be used for plants that require acid soil conditions. Soils containing free limestone should not be used for plants that require acid soil conditions or are sensitive to limestone.

FGL, Inc.

Darrell H. Nelson



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DES-BEE-DOVE COAL MINES

EMERY COUNTY, UTAH

DES-BEE-DOVE/WILBERG JUNCTION ROAD SOIL SAMPLE LOCATION MAP

UTAH POWER & LIGHT COMPANY
DEPARTMENT OF MINING & EXPLORATION

DRAWN BY: SMC	CHECKED BY:	DATE: 3-15-85
SCALE 0 400' 800'	SHEET NO. 1 of 1	DRAWING NUMBER CM-10613-D