APPENDIX 2-3B

SUPPLEMENTAL SOIL INVENTORY

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REVISED 6/19/97

1.0 INTRODUCTION

The soil resources to be disturbed by the proposed culvert expansion have been previously mapped and reported by the U.S. Forest Service (USFS). Portions of the USFS report are based on field work conducted by Forest Service personnel and the "Soil Survey of Parts of the Price River and Huntington River Watersheds" by John L. Swenson, Wesley Ketch, and Laurel Stott, December 1983. The USFS report is a work in progress and is being prepared by Mr. Dan Larson of the USFS Manti-Lasal National Forest Price, Utah office.

In addition to the general description of the area soils provided in the USFS draft report, the soils within the proposed disturbed area were mapped, sampled, and described by Mr. Randy Gainer (formerly a Genwal Resources employee), Mr. Chris Hansen (EarthFax Engineering, Inc.), and Mr. David Steed (EIS). The field work necessary to map the area soils was conducted during the summers of 1995 and 1996. The field work included hand digging soil pits, logging the pits, sampling the various soil horizons, and submitting soil samples to the laboratory for analysis.

To present the findings of the Genwal Resources soils investigation, this appendix has been divided into eight sections, including this introduction. The sections are as follows:

SECTION	TITLE
1.0	Introduction
2.0	Soil Identification
3.0	Soil Descriptions
4.0	Wetlands and Riparian Area
5.0	Laboratory Testing and Interpretation of Results
6.0	Topsoil and Subsoil Salvage
7.0	Topsoil Protection and Redistribution
8.0	Tables of Analytical Results

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2.0 SOIL IDENTIFICATION

The soils in Crandall Canyon have been generally mapped by the USFS on an Order III survey level. The results of the survey indicate that the soils on the south side of Crandall Canyon are part of the Curecanti-Elwood-Duchesne Families Complex (Map Unit 107) and Bundo-Lucky Star-Adel Families Complex (Map Unit 711). The boundaries of these soil units are illustrated at a scale of 1:50 on Plate 2-4 which is presented as part of this appendix. In addition to these soil family complexes, small inclusions of alluvial/colluvial soils have been mapped in the bottom of the canyon. These small inclusions are the soils that will generally be disturbed by construction of the proposed culvert.

3.0 SOIL DESCRIPTIONS

3.1 CURECANTI-ELWOOD-DUCHESNE FAMILIES COMPLEX

The Curecanti-Elwood-Duchesne families complex consist of 35% Curecanti family soils, 25% Elwood family soils, 25% Duchesne family soils, and 15% rock outcrop, shallow soils, and more sandy or more clayey soils. The Curecanti family soils are Mixed Typic Argiborolls, loamy-skeletal loam to stony loam, 20 to 70% slopes, derived from sandstone and colluvium, and support sagebrush and mountain brush vegetative communities. The Elwood family soils are Mixed Argic Cryoborolls, loamy-skeletal loam to cobbly clayey loam to fine sandy loam, 20 to 60% slopes, derived from sandstone, shale, and colluvium, and support mountain brush vegetative communities. The Duchesne family soils are Mixed Typic Cryoboralfs, loamy-skeletal, loam to cobbly clay loam, 20 to 80% slope, derived from sandstone and colluvium, and support Douglas fir and White fir vegetative communities.

3.2 BUNDO-LUCKY STAR-ADEL FAMILIES COMPLEX

The Bundo-Lucky Star-Adel families complex consists of 50% Bundo family soils, 20% Lucky Star family soils, 20% Adel family soils, and 10% contrasting inclusions of rock outcrop and more clayey soils. The Bundo family soils are Mixed Typic Paleboralfs, loamy-skeletal fine sandy to cobbly loam, 40 to 70% slopes, derived from sandstone, and support spruce/fir vegetative communities. The Lucky Star family soils are Mixed Boralfic Cryoborolls, loamy-skeletal cobbly very fine sandy loam to cobbly clay loam, 30 to 60% slopes, derived from colluvium of sandstone and shale~~, and support spruce-fir, aspen,~~ and mixed fir and aspen vegetative communities. The Lucky Star family soils are Mixed Pachic Cryoborolls, loamy-skeletal loam and silty loam, 30 to 60% slopes, derived from sandstone, shale, limestone, and colluvium, and support aspen vegetative communities.

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3.3 INCLUSIONS

Two inclusions were identified in the proposed culvert expansion area. The two inclusions are illustrated as Map Units A and B on attached Plate 2-4. Map Unit A is located on the north side of Crandall Canyon while Map Unit B is located on the south side of the creek.

3.3.1 Map Unit A

This unit is located south of the warehouse on a terrace above the canyon floor. It is a mix of colluvial and fluvial/alluvial deposits. The colluvium is derived from the steep slopes and rock outcrops on the north wall of the canyon while the fluvial/alluvial material was deposited by Crandall Canyon Creek and the small drainage north of the warehouse. These sediments are intermixed and distinguishing between fluvial/alluvial and colluvium deposits would be difficult. These materials have been in place a sufficient period of time to allow for the initial development of poor soil horizons. However, according to Mr. Gainer, these soils should be considered to belong to the soil order Entisol. Following is a description of the soils found in soil pit TP-3 which is located within Map Unit A. This pit was excavated in an area where the slope is gentle to very steep and the soils are moderately well drained. Additionally, the soil color provided in the description below are in-situ condition colors only.

Soil Profile

0.0-0.2' dark grayish brown (10YR 4/2) sandy loam, approximately 5% rock fragments, structureless, loose, non-sticky and non-plastic, common fine roots, no pores, slightly to strongly effervescent, boundary is smooth abrupt, dry.

0.2-0.7' brown (10YR 4/3) sandy loam, approximately 15% or less rock fragments, structureless, loose, non-sticky and non-plastic, common fine and medium roots, no pores, slight to strongly effervescent, boundary is smooth abrupt, dry.

0.7-1.3' dark brown (10YR 3/3) sandy loam, approximately 15% or less rock fragments, weak prismatic (apparent) to structureless, loose, slightly sticky and slightly plastic, common fine and few medium roots, no pores, strongly effervescent, boundary is wavy abrupt, dry.

1.3-1.7' very dark grayish brown (10YR 3/2) very stony loam, 30 to 50% rock fragments consisting of 20% pebbles, 30% cobble, and 50% stone, weak prismatic (apparent) to structureless, loose, non-sticky and non-plastic, common fine and medium roots with few coarse roots, few fine pores, slightly effervescent,

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calcareous efflorescence on rock fragment surfaces, boundary is smooth abrupt, dry.

1.7-3.3' brown (10YR 4/3) sandy loam, approximately 15% and less irregular to subrounded pebbles, weak subangular blocky, loose, non-sticky and non-plastic, few medium and coarse roots, no pores, slight calcareous efflorescence on rock surfaces with occasional calcite veins in sandy loam, strongly effervescent, dry.

The structures observed in the horizons of the above described soil were extremely weak and may be the result of natural compaction and dessication rather than true soil development.

Samples from each of the above described horizons were obtained and sent to a certified laboratory for analysis of selected parameters. The results are presented in Table 8-1 attached to this report. The results are discussed in greater detail in Section 4.0 of this report.

3.3.2 Map Unit B

This unit is located in the bottom of the canyon and generally consists of poorly developed sandy loams that have been recently deposited as fluvial sediments by Crandall Creek. The soil has generally not been in place long enough to have mechanically or chemically well developed horizons. With the exception of the overlying organic layer, the soil horizons appear to be the result of episodic deposition rather than in-place soil development. For this reason, these soils may be considered to be of the Entisol soil order. Following is a description of the soils found in soil pit TP-4 located within Map Unit B. This pit was excavated in an area where the slope is gentle to strongly sloping and the soils are moderately well drained. Additionally, the soil color provided in the description below are in-situ condition colors only.

Soil Profile

0.0-0.5' very dark brown (7.5YR 2.5/2) sandy loam, less than 1% rock fragments, structureless (single grain), loose, non-sticky and non-plastic, many fine roots, no pores, slightly effervescent, boundary is smooth wavy, dry.

0.5-0.9' very dark grayish brown (10YR 3/2) sandy loam and sand, less than 1% rock fragments, weakly prismatic (apparent) to structureless, loose, non-sticky and non-plastic, common fine and medium roots, no pores, slightly to strongly effervescent, boundary is smooth gradual, dry.

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0.9-1.8' weak red (2.5YR 5/3) sandy loam, less than 2% rock fragments, weak prismatic (apparent) to structureless, loose, non-sticky and non-plastic, common fine roots, few medium and coarse roots, no pores, strongly effervescent, boundary is smooth abrupt, dry.

1.8-2.3' dark grayish brown (10YR 4/2) loam, less than 2% rock fragments, weak blocky, loose, non-sticky and non-plastic, many medium and coarse roots, no pores, slightly effervescent, boundary is abrupt, dry. Appears to be a paleosol.

2.3-3.3' very dark grayish brown (10YR 3/2) loam, less than 5% rock fragments, weak blocky, loose, slightly sticky and slightly plastic, common fine and medium roots and many coarse roots, no pores, some orange streaking in soil from decomposing organic material (roots, twigs, etc.) strongly effervescent, boundary is abrupt, dry.

3.3-4.5' dark brown (7.5YR 3/2) sandy loam, less than 5% rock fragments, weak subangular blocky, loose, non-sticky and non-plastic, common fine and medium roots, no pores, some orange streaking in soil from decomposing organic material (roots, twigs, etc.) or iron staining, strongly effervescent, moist.

The structures observed in the horizons of the above described soil were extremely weak and may be the result of natural compaction and dessication rather than true soil development.

Samples from each of the above described horizons were obtained and sent to a certified laboratory for analysis of selected parameters. The results are presented in Table 8-1 attached to this report. The results are discussed in greater detail in Section 4.0 of this report.

3.4 ADDITIONAL SOILS INFORMATION

Additional soils pits have been excavated in the vicinity of the proposed culvert disturbed area by both Genwal and EIS personnel. Soil pit TH-2 was excavated by hand by Genwal personnel on the south face of Crandall Canyon and directly across from the current load-out facility (Plate 2-4). This pit was excavated near the proposed disturbed area boundary. Samples were obtained from each horizon and the results of sample analysis are presented in Table 8-2 attached to this report. The field description of the soils is presented below.

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Soil Profile

0.0-0.13' dark reddish brown (5YR 2.5/2) organic sandy loam.

0.13-0.25' very dark brown (10YR 2/2) sandy loam, common very fine and fine roots, highly decomposed organics.

0.25-0.50' dark yellowish brown (10YR 4/4) sandy loam, common fine to medium roots, slightly blocky, gradual boundary.

0.50-1.10' yellow (10YR 7/6) sandy loam, many fine to medium roots, weak subangular blocky, 10% pebbles, weathered sandstone, clear boundary.

1.10-1.85' strong brown (7.5YR 5/8) cobbly loam, moderate subangular blocky, weathered sandstone rock fragments, directly overlies weathered bedrock.

Additional soil pits were excavated in August 1995 by EIS personnel in soils adjacent to Crandall Canyon Creek. Six samples were obtained from soils that EIS identified as supporting riparian vegetation. An additional two samples were obtained from the soil inclusion area Map Unit B. The location of the samples are illustrated on Plate 2-4. The locations are labeled as SS-1 through SS-6 Riparian and Bench 1 and 2. Composite samples were obtained from each of these sampling sites and the results of the sample analysis are summarized in Tables 8-3 and 8-4. The pits were generally excavated to a depth between 18 and 30 inches. The soils were generally sandy loam and cobbly sandy loam. Detailed soils logs are not available for these soils pits.

4.0 WETLANDS AND RIPARIAN AREAS

No wetlands are known to exist along the proposed culvert expansion route. Some intermittent riparian vegetation is present, as noted previously, although the canyon bottom is narrow and steep with numerous sections of slickrock. The soils within the areas along the stream bank which contain riparian vegetation will not be removed. The vegetation will be removed to allow the placement of geotextile fabric for the culvert construction. Upon reclamation and removal of the fabric, the vegetation will be re-established. Leaving the soil in place would preserve much of the soil structure and should allow for rapid revegetation, slope stabilization, and erosion control. In areas where soil compaction occurs, the soils will treated using the best technology currently available (BTCA) at the time of reclamation to alleviate the compacted condition.

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5.0 LABORATORY TESTING AND INTERPRETATION OF RESULTS

Samples were collected to evaluate the inherent property of the soils within and adjacent to the proposed culvert disturbed , assess its potential for being acid- or toxic-forming, and to determine vegetation re-establishment potential in accordance with general Division requirements. In soils pits TH-2, TP-3, and TP-4 the material sampled was relatively undisturbed and samples were obtained from soil horizons that appeared to be unique or different in some way from the overlying and/or underlying soils. Samples were collected from the sidewall of the excavation using a geologic hammer and shovel. In soil pits SS-1 through SS-6 Riparian and Bench 1 and 2, a composite sample was obtained of the soils encountered. Selected analyses results for samples from each soils pit are summarized in Section 8.0 of this appendix, Table 8-1 through 8-4. Laboratory results of soil sampling are reported in full in Attachment A of this appendix.

Samples from soil pits TP-3 and TP-4 were sent to the Inter-Mountain Laboratories, Inc. (IML) in Laramie, Wyoming for analysis for the parameters listed in Table 1 (except alkalinity), "Analytical Methods for Baseline Soils Data" and Table 2, "Overburden Evaluation for Vegetative Root Zone" from the "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining" (Leatherwood and Duce, 1988). Based on the analyses results, the soils from these soil pits fall within the acceptable ranges for the physio-chemical properties listed in Table 2 (Leatherwood and Duce, 1988) and are suitable for use in reclamation.

Soil samples from soil pit TH-2 were sent to Commercial Testing and Engineering Company (CTE) in Huntington, Utah for analysis of the parameters (except potassium) for analysis of the parameters listed in Table 1 (Leatherwood and Duce, 1988). Based on the analyses results, the soils from these soil pits fall within the acceptable ranges for the applicable physio-chemical properties listed in Table 2 (Leatherwood and Duce, 1988) with the exception of available water capacity (AWC),. The AWC of these samples tend to be less than the minimum 5% at 15 atm. Since these soils will not be disturbed or used as a substitute topsoil, this aspect of the soils is inconsequential to the culvert expansion project.

Soil samples from soil pits SS-1 through SS-6 Riparian and Bench 1 and 2 were sent to IML in Farmington, New Mexico for analysis for the parameters listed in Table 1 and Table 6 (Leatherwood and Duce, 1988). Based on the analyses results, the soils from these soil pits generally fall within the acceptable ranges for the applicable physio-chemical properties listed in Table 2 (Leatherwood and Duce, 1988). Again, the AWC for the samples from the riparian areas tend to be less than the acceptable 5%. These soils are naturally very sandy and would not be capable of retaining significant soil moisture for extended periods. Since these samples were obtained from soils adjacent to the stream

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(Plate 2-4), frequent saturation of these soils probably occur as a result of runoff from spring thaws or summer thunderstorms. Also, these soils will only be disturbed to the extent of removing the vegetation and placement of geotextile material.

6.0 TOPSOIL AND SUBSOIL SALVAGE

Topsoil and subsoil will be salvaged from the two areas identified as Map Units A and B prior to beginning construction activities within those areas. The "topsoil" materials will be stored on the existing lower-most topsoil stockpile, Stockpile #3, which is located along the side of the mine access road.

7.0 TOPSOIL PROTECTION AND REDISTRIBUTION

All stockpiled topsoil and subsoil will be maintained, protected, and redistributed according to the plans outlined in Chapter 2.0 of the M&RP.

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TABLE 8-1

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST PITS 3 AND 4

Parameter	Units	UDOGM Acceptable Range	Sample Number		
			TP-3 0-0.2	TP-3 0.2-0.5	TP-3 0.7-1.3
pH		4.5 - 9.0	7.2	7.4	7.3
EC	mmhos/cm	0 - 15	0.57	0.40	0.38
Saturation %		25 - 80%	32.4	26.9	29.6
Calcium	meq/L		3.51	2.90	2.72
Magnesium	meq/L		0.65	0.51	0.70
Sodium	meq/L		1.58	0.63	0.44
SAR		0 - 12,15	1.10	0.48	0.51
Nitrate-N	ppm		3.56	4.48	5.26
Phosphorus	ppm		4.56	1.52	1.43
Organic-C	%		3.5	1.5	4.0
Na (NH_4OAC)	meq/100g		0.34	0.36	0.21
H_2O - 1/3 Atm	%		11.3	7.4	12.4
- 15 Atm	%	5 - >10%	5.5	3.8	5.4
Boron	ppm	<5.0	0.31	0.17	0.18
Selenium	ppm	<0.1	<0.02	<0.02	<0.02
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	93.9	77.8	190
Texture			Sandy Loam	Sandy Loam	Sandy Loam

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TABLE 8-1 (cont.)

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST PITS 3 AND 4

Parameter	Units	UDOGM Acceptable Range	Sample Number TP-3 1.3-1.7	TP-3 1.7-3.0	TP-4 0.0-0.5
pH		4.5 - 9.0	7.2	7.3	7.1
EC	mmhos/cm	0 - 15	0.37	0.33	0.38
Saturation %		25 - 80%	32.3	29.5	42.2
Calcium	meq/L		2.52	2.24	2.97
Magnesium	meq/L		0.66	0.54	0.55
Sodium	meq/L		.60	0.74	0.47
SAR		0 - 12,15	0.48	0.63	0.35
Nitrate-N	ppm		1.72	1.68	4.16
Phosphorus	ppm		1.25	1.40	11.4
Organic-C	%		3.4	2.4	6.7
Na (NH_4OAC)	meq/100g		0.21	0.25	0.32
H_2O - 1/3 Atm	%		11.0	11.3	19.0
- 15 Atm	%	5 - >10%	6.1	5.1	8.8
Boron	ppm	<5.0	0.20	0.17	0.29
Selenium	ppm	<0.1	<0.02	<0.02	<0.1
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	115	105	35.8
Texture			Sandy Loam	Sandy Loam	Sandy Loam

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TABLE 8-1 (cont.)

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST PITS 3 AND 4

Parameter	Units	UDOGM Acceptable Range	Sample Number		
			TP-4 0.5-0.9	TP-4 0.9-1.8	TP-4 1.8-2.3
pH		4.5 - 9.0	7.2	7.2	7.3
EC	mmhos/cm	0 - 15	0.38	0.27	0.27
Saturation %		25 - 80%	45.6	38.0	47.9
Calcium	meq/L		3.02	1.87	2.13
Magnesium	meq/L		0.53	0.44	0.44
Sodium	meq/L		0.40	0.51	0.47
SAR		0 - 12,15	0.30	0.47	0.41
Nitrate-N	ppm		2.98	1.98	2.06
Phosphorus	ppm		9.40	7.49	7.85
Organic-C	%		4.5	3.3	5.2
Na (NH_4OAC)	meq/100g		0.27	0.29	0.26
H_2O - 1/3 Atm	%		18.5	13.6	21.4
- 15 Atm	%	5 - >10%	9.2	6.4	9.2
Boron	ppm	<5.0	0.19	0.17	0.26
Selenium	ppm	<0.1	<0.02	<0.02	<0.021
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	110	122	106
Texture			Sandy Loam	Sandy Loam	Loam

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TABLE 8-1 (cont.)

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST PITS 3 AND 4

Parameter	Units	UDOGM Acceptable Range	Sample Number TP-4 2.3-3.3	Sample Number TP-4 3.3-4.5
pH		4.5 - 9.0	7.3	7.5
EC	mmhos/cm	0 - 15	0.33	0.36
Saturation %		25 - 80%	52.4	35.0
Calcium	meq/L		2.71	2.62
Magnesium	meq/L		0.61	0.75
Sodium	meq/L		0.35	0.60
SAR		0 - 12,15	0.27	0.46
Nitrate-N	ppm		2.04	1.54
Phosphorus	ppm		2.01	1.09
Organic-C	%		5.9	3.1
Na (NH_4OAC)	meq/100g		0.15	0.25
H_2O - 1/3 Atm	%		22.0	13.0
- 15 Atm	%	5 - >10%	11.0	5.8
Boron	ppm	<5.0	0.23	0.21
Selenium	ppm	<0.1	<0.02	<0.02
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	160	85.3
Texture			Loam	Sandy Loam

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TABLE 8-2

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST HOLE 2

Parameter	Units	UDOGM Acceptable Range	Sample Number TH-2 0.13-0.25'	Sample Number TH-2 0.25-0.50'
pH		4.5 - 9.0	6.4	6.2
EC	mmhos/cm	0 - 15	0.57	0.35
Saturation %		25 - 80%	32.6	45.6
Calcium	meq/L		3.96	2.04
Magnesium	meq/L		1.44	0.71
Sodium	meq/L		0.27	0.51
SAR		0 - 12,15	0.17	0.44
Total N	%		1.29	0.09
Phosphorus	mg/kg		14.3	2.21
Organic-C	%		44.3	2.4
Rock Fragments	%		0.0	0.0
H_2O - 1/3 Atm	%		NA*	5.0
- 15 Atm	%	5 - >10%	NA*	4.4
Alkalinity	meq/L		4.94	2.22
Carbonate	%		1.7	0.1
Color (Laboratory)			5YR 2.5/1	10YR 6/3
Texture			Sandy Loam	Silty Loam

NA* Insufficient sample to perform Available Water Capacity analysis.

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TABLE 8-2 (cont.)

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM TEST HOLE 2

Parameter	Units	UDOGM Acceptable Range	Sample Number TH-2 0.50-1.10'	Sample Number TH-2 1.10-1.85'
pH		4.5 - 9.0	5.9	6.2
EC	mmhos/cm	0 - 15	0.27	0.24
Saturation %		25 - 80%	26.4	25.4
Calcium	meq/L		1.43	1.25
Magnesium	meq/L		0.48	0.76
Sodium	meq/L		0.52	1.14
SAR		0 - 12,15	0.53	1.13
Total N	%		0.08	0.37
Phosphorus	mg/kg		0.74	0.31
Organic-C	%		1.7	2.6
Rock Fragments	%		0.6	6.5
H_2O - 1/3 Atm	%		4.9	7.1
- 15 Atm	%	5 - >10%	3.9	4.9
Alkalinity	meq/L		1.28	0.92
Carbonate	%		<0.1	0.1
Color (Laboratory)			10YR 6/3	10YR 6/4
Texture			Sandy Loam	Loam

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TABLE 8-3

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM THE RIPARIAN AREA SAMPLE SITES 1 THROUGH 6

Parameter	Units	UDOGM Acceptable Range	Sample Number		
			SS-1 Riparian Composite	SS-2 Riparian Composite	SS-3 Riparian Composite
pH		4.5 - 9.0	7.5	7.5	7.7
EC	mmhos/cm	0 - 15	0.57	1.66	0.81
Saturation %		25 - 80%	31.2	32.8	34.7
Calcium	meq/L		2.71	8.17	4.73
Magnesium	meq/L		2.13	3.16	2.82
Sodium	meq/L		0.95	6.17	1.05
SAR		0 - 12,15	0.61	2.59	0.54
Carbonate	%		12.6	8.0	16.3
Phosphorus	ppm		2.90	4.06	5.87
Organic-C	%		0.7	0.8	1.6
Alkalinity	meq/L		3.66	2.80	2.89
Na (NH_4OAC)	meq/100g		0.30	0.46	0.32
H_2O - 1/3 Atm	%		5.1	7.2	14.7
- 15 Atm	%	5 - >10%	4.1	5.1	5.8
Total N	%		0.03	0.03	0.06
Selenium	ppm	<0.1	<0.02	<0.02	<0.02
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	109	65.8	153
Texture			Sand	Loamy Sand	Sandy Loam

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TABLE 8-3 (cont.)

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM THE RIPARIAN AREA SAMPLE SITES 1 THROUGH 6

Parameter	Units	UDOGM Acceptable Range	Sample Number		
			SS-4 Riparian Composite	SS-5 Riparian Composite	SS-6 Riparian Composite
pH		4.5 - 9.0	7.7	7.7	7.6
EC	mmhos/cm	0 - 15	0.45	0.66	1.58
Saturation %		25 - 80%	33.2	46.1	32.5
Calcium	meq/L		2.96	3.71	12.8
Magnesium	meq/L		1.03	2.10	5.07
Sodium	meq/L		0.42	1.17	0.63
SAR		0 - 12,15	0.30	0.69	0.21
Carbonate	%		10.5	14.1	9.6
Phosphorus	ppm		3.56	4.92	4.12
Organic-C	%		0.9	1.7	1.0
Alkalinity	meq/L		2.17	2.89	2.12
Na (NH_4OAC)	meq/100g		0.27	0.31	0.26
H_2O - 1/3 Atm	%		6.4	16.1	10.3
- 15 Atm	%	5 - >10%	5.1	4.1	4.1
Total N	%		0.05	0.07	0.04
Selenium	ppm	<0.1	<0.02	<0.02	<0.02
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	96.5	138	84.7
Texture			Loamy Sand	Sandy Loam	Loamy Sand

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UTAH DIVISION OIL, GAS AND MINING

TABLE 8-4

SELECT GENWAL CRANDALL CANYON MINE SOIL ANALYTICAL DATA FOR SOILS FROM THE BENCH AREA SAMPLE SITES 1 AND 2

Parameter	Units	UDOGM Acceptable Range	Sample Number	
			SS-1 Bench Composite	SS-2 Bench Composite
pH		4.5 - 9.0	7.7	7.7
EC	mmhos/cm	0 - 15	0.37	0.33
Saturation %		25 - 80%	43.1	47.6
Calcium	meq/L		3.16	2.96
Magnesium	meq/L		0.42	0.29
Sodium	meq/L		0.30	0.19
SAR		0 - 12,15	0.22	0.15
Carbonate	%		4.0	9.7
Phosphorus	ppm		15.1	6.83
Organic-C	%		3.1	3.6
Alkalinity	meq/L		2.55	2.46
Na (NH_4OAC)	meq/100g		0.25	0.24
H_2O - 1/3 Atm	%		17.9	20.6
- 15 Atm	%	5 - >10%	11.0	12.8
Total N	%		0.15	0.16
Selenium	ppm	<0.1	<0.02	<0.02
Acid/Base Potential	tons $CaCO_3$/ 1,000 tons material	> -5	29.8	89.3
Texture			Sandy Loam	Sandy Loam

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ATTACHMENT A

ANALYTICAL DATA FROM THE SOIL SAMPLING PROGRAM
PROPOSED CRANDALL CANYON CULVERT EXPANSION

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Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

EARTHFAX ENGINEERING, INC.
MIDVALE, UTAH

July 25, 1996

Lab No.	Location	Depths feet	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
134105	TP-3	0.0-0.2	7.2	0.57	32.4	3.51	0.65	1.58	1.10	23.1	66.0	24.0	10.0	SANDY LOAM
134106		0.2-0.5	7.4	0.40	26.9	2.90	0.51	0.63	0.48	5.9	77.0	13.0	10.0	SANDY LOAM
134107		0.7-1.3	7.3	0.38	29.6	2.72	0.44	0.64	0.51	5.9	68.0	19.0	13.0	SANDY LOAM
134108		1.3-1.7	7.2	0.37	32.3	2.52	0.66	0.60	0.48	31.8	71.0	19.0	10.0	SANDY LOAM
134109		1.7-3.0	7.3	0.33	29.5	2.24	0.54	0.74	0.63	17.7	68.0	20.0	12.0	SANDY LOAM
134110	TP-4	0.0-0.5	7.1	0.38	42.2	2.97	0.55	0.47	0.35	1.4	64.0	27.0	9.0	SANDY LOAM
134111		0.5-0.9	7.2	0.38	45.6	3.02	0.53	0.40	0.30	0.0	59.0	31.0	10.0	SANDY LOAM
134112		0.9-1.8	7.2	0.27	38.0	1.87	0.44	0.51	0.47	0.0	64.0	25.0	11.0	SANDY LOAM
134113		1.8-2.3	7.3	0.27	47.9	2.13	0.44	0.47	0.41	0.0	51.0	39.0	10.0	LOAM
134114		2.3-3.3	7.3	0.33	52.4	2.71	0.61	0.35	0.27	0.0	50.0	34.0	16.0	LOAM
134115		3.3-4.5	7.5	0.36	35.0	2.62	0.75	0.60	0.46	0.0	64.0	25.0	11.0	SANDY LOAM

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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EARTHFAX ENGINEERING, INC.
MIDVALE, UTAH

July 25, 1996

Lab No.	Location	Depths feet	Total Organic Carbon %	Total Sulfur %	T.S. AB t/1000t	Neut. Pot. t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t
134105	TP-3	0.0-0.2	3.5	0.01	0.31	94.2	93.9					
134106		0.2-0.5	1.5	0.01	0.31	78.1	77.8					
134107		0.7-1.3	4.0	<0.01	0.00	190.	190.					
134108		1.3-1.7	3.4	<0.01	0.00	115.	115.					
134109		1.7-3.0	2.4	<0.01	0.00	105.	105.					
134110	TP-4	0.0-0.5	6.7	0.02	0.62	36.5	35.8					
134111		0.5-0.9	4.5	0.02	0.62	110.	110.					
134112		0.9-1.8	3.3	0.01	0.31	122.	122.					
134113		1.8-2.3	5.2	0.02	0.62	107.	106.					
134114		2.3-3.3	5.9	0.03	0.94	161.	160.					
134115		3.3-4.5	3.1	0.01	0.31	85.6	85.3					

UTAH DIVISION OIL, GAS AND MINING
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EFFECTIVE:
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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

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EARTHFAX ENGINEERING, INC.
MIDVALE, UTAH

July 25, 1996

Lab No.	Location	Depths feet	P ppm	K ppm	Nitrate-Nitrogen ppm	Boron ppm	Selenium ppm	Avail Na meq/100g	Exch Na meq/100g	Total Kjeldahl Nitrogen %	1/3 bar	15 bar
134105	TP-3	0.0-0.2	4.56	91.0	3.56	0.31	<0.02	0.34	0.29	0.15	11.3	5.5
134106		0.2-0.5	1.52	64.0	4.48	0.17	<0.02	0.36	0.34	0.10	7.4	3.8
134107		0.7-1.3	1.43	63.0	5.26	0.18	<0.02	0.23	0.21	0.11	12.4	5.4
134108		1.3-1.7	1.25	54.0	1.72	0.20	<0.02	0.23	0.21	0.14	11.0	6.1
134109		1.7-3.0	1.40	65.0	1.68	0.17	<0.02	0.27	0.25	0.11	11.3	5.1
134110	TP-4	0.0-0.5	11.4	179.	4.16	0.29	<0.02	0.34	0.32	0.25	19.0	8.8
134111		0.5-0.9	9.40	99.0	2.98	0.19	<0.02	0.29	0.27	0.17	18.5	9.2
134112		0.9-1.8	7.49	99.0	1.98	0.17	<0.02	0.31	0.29	0.12	13.6	6.4
134113		1.8-2.3	7.85	112.	2.06	0.26	<0.02	0.28	0.26	0.18	21.4	9.2
134114		2.3-3.3	2.01	57.0	2.04	0.23	<0.02	0.17	0.15	0.18	22.0	11.0
134115		3.3-4.5	1.09	73.0	1.54	0.21	<0.02	0.27	0.25	0.11	13.0	5.8

UTAH DIVISION OIL, GAS AND MINING
JUL 30 1997
INCORPORATED
EFFECTIVE:
MB

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

(E.I.S.) GENWAL COAL CO.
Helper, Utah
MINE: Mine
LOCATION: Riparian / Bench

DATE SAMPLED: August 19, 1994
DATE REPORTED: October 20, 1994

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Sand %	Silt %	Clay %	Texture	Organic Matter %
36374	SS 1 RIPARIAN		7.5	0.57	31.2	2.71	2.13	0.95	0.61	92.0	4.0	4.0	SAND	0.7
36375	SS 2 RIPARIAN		7.5	1.66	32.8	8.17	3.16	6.17	2.59	80.0	14.0	6.0	LOAMY SAND	0.8
36376	SS 3 RIPARIAN		7.7	0.81	34.7	4.73	2.82	1.05	0.54	76.0	16.0	8.0	SANDY LOAM	1.6
36377	SS 4 RIPARIAN		7.7	0.45	33.2	2.96	1.03	0.42	0.30	78.0	18.0	4.0	LOAMY SAND	0.9
36378	SS 5 RIPARIAN		7.7	0.66	46.1	3.71	2.10	1.17	0.69	70.0	22.0	8.0	SANDY LOAM	1.7
36379	SS 6 RIPARIAN		7.6	1.58	32.5	12.8	5.07	0.63	0.21	76.0	18.0	6.0	LOAMY SAND	1.0
36380	SS 1 BENCH		7.7	0.37	43.1	3.16	0.42	0.30	0.22	58.0	28.0	14.0	SANDY LOAM	3.1
36381	SS 2 BENCH		7.7	0.33	47.6	2.96	0.29	0.19	0.15	58.0	26.0	16.0	SANDY LOAM	3.6

INCORPORATED
EFFECTIVE:
JUL 30 1997
UTAH DIVISION OIL, GAS AND MINING

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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Farmington, New Mexico 87401
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(E.I.S.) GENWAL COAL CO.
Helper, Utah
MINE: Mine
LOCATION: Riparian / Bench

DATE SAMPLED: August 19, 1994
DATE REPORTED: October 20, 1994

Lab No.	Location	Depths	Carbonate %	Total Sulfur %	T.S. AB t/1000t	Neut. Pot. t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t	P ppm	Avail Na meq/100g	Exch Na meq/100g
36374	SS 1 RIPARIAN		12.6	-0.01	0.06	109.	109.	<0.01	<0.01	<0.01	-0.01	109.	2.90	0.33	0.30
36375	SS 2 RIPARIAN		8.0	-0.01	0.26	65.8	65.6	<0.01	<0.01	<0.01	-0.01	65.8	4.06	0.66	0.46
36376	SS 3 RIPARIAN		16.3	-0.01	0.27	153.	153.	<0.01	0.01	<0.01	0.36	153.	5.87	0.36	0.32
36377	SS 4 RIPARIAN		10.5	-0.01	0.06	96.5	96.4	<0.01	<0.01	<0.01	-0.01	96.5	3.56	0.28	0.27
36378	SS 5 RIPARIAN		14.1	0.02	0.62	138.	137.	0.01	<0.01	<0.01	-0.01	138.	4.92	0.36	0.31
36379	SS 6 RIPARIAN		9.6	-0.01	0.13	84.7	84.6	<0.01	<0.01	<0.01	-0.01	84.7	4.12	0.28	0.26
36380	SS 1 BENCH		4.0	-0.01	0.29	29.8	29.5	<0.01	<0.01	<0.01	-0.01	29.8	15.1	0.26	0.25
36381	SS 2 BENCH		9.7	0.02	0.57	89.3	88.7	<0.01	<0.01	<0.01	-0.01	89.3	6.83	0.25	0.24

INCORPORATED
EFFECTIVE:
JUL 30 1997
UTAH DIVISION OIL, GAS AND MINING

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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MINE: Mine
LOCATION: Riparian / Bench

DATE SAMPLED: August 19, 1994
DATE REPORTED: October 20, 1994

Lab No.	Location	Depths	CEC meq/100g	ESP	K PE meq/l	Alkalinity PE meq/l	Total Selenium ppm	Bulk Density	Total Kjeldahl Nitrogen %	1/3 bar	15 bar	H2O Sol Selenium ppm
36374	SS 1 RIPARIAN		2.50	12.0	0.17	3.66	0.15		0.03	5.1	4.1	<0.02
36375	SS 2 RIPARIAN		9.00	5.08	0.20	2.80	0.15	1.24	0.03	7.2	5.1	<0.02
36376	SS 3 RIPARIAN		10.3	3.14	0.14	2.89	0.35	1.40	0.06	14.7	5.8	<0.02
36377	SS 4 RIPARIAN		8.50	3.13	0.33	2.17	0.20		0.05	6.4	5.1	<0.02
36378	SS 5 RIPARIAN		11.1	2.75	0.12	2.89	0.55	1.66	0.07	16.1	4.1	<0.02
36379	SS 6 RIPARIAN		9.62	2.70	0.22	2.12	0.55	1.46	0.04	10.3	4.1	<0.02
36380	SS 1 BENCH		28.4	0.87	0.18	2.55	0.20	1.19	0.15	17.9	11.0	<0.02
36381	SS 2 BENCH		32.4	0.74	0.14	2.46	0.80	1.09	0.16	20.6	12.8	<0.02

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Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, ABPTA= Ammonium Bicarbonate-DPTA, AAO- Acid Ammonium Oxalate
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

Inter-Mountain Laboratories, Inc.

2506 W. Main Street
Farmington, New Mexico 87401

Environmental Industrial Services
Munsell Color

Lab No.	Location	Color
36374	SS1 Riparian	10 YR 5/3 Brown
36375	SS2	10YR 5/4 Yellowish brown
36376	SS3	2.5Y 6/3 Light yellowish brown
36377	SS4	2.5Y 5.5/3 Light olive brown
36378	SS5	2.5Y 5/3 Light olive brown
36379	SS6	2.5Y 5/3 Light olive brown
36380	SS1 Bench	10YR 3/2 Very dark grayish brown
36381	SS2	10YR 4/2 Dark grayish brown

INCORPORATED
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COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-8300 FAX: 708-953-9306
SINCE 1908
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TEL: (801) 653-2311
FAX: (801) 653-2436

July 30, 1995

GENWAL COAL CO.
P.O. BOX 1201
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

Kind of sample reported to us: ~~Coal~~ Soil

Sample taken at: Genwal

Sample taken by: Genwal

Date sampled: June 26, 1995

Date received: June 27, 1995

Th #2
1 Bag

NOTE: Insufficient sample to complete 1/3 and 15 bars.

Analysis report no. 59-182264

SOIL ANALYSIS

pH	6.4 units
Conductivity	0.57 mmhos/cm
Saturation %	326.

PARTICLE SIZE ANALYSIS

% Sand	52.2
% Silt	32.0
% Clay	15.8
Texture	Sandy Loam

SOLUBLE CATIONS

Calcium	3.96 meq/l
Magnesium	1.44 meq/l
Sodium	0.27 meq/l

Sodium Adsorption Ratio 0.17

Munsell Color 5YR 2.5/1, Black

Rock Fragments	0.0 %
Total Nitrogen	1.29 %
Organic Carbon	44.3 %
Carbonate	1.7 %
Available Phosphorus	14.3 mg/Kg
Alkalinity	4.94 meq/liter

Available Water Capacity
NA (1/3)
NA (15)

INCORPORATED
EFFECTIVE:
JUL 30 1007 97B
UTAH DIVISION OIL, GAS AND MINING

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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July 30, 1995

GENWAL COAL CO.
P.O. BOX 1201
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

Kind of sample reported to us: ~~Coal~~ Soil

Sample taken at: Genwal

Sample taken by: Genwal

Date sampled: June 26, 1995

Date received: June 27, 1995

B1 Th #2
1 Bag

Analysis report no. 59-182269

SOIL ANALYSIS

pH	6.2 units
Conductivity	0.35 mmhos/cm
Saturation %	45.6

PARTICLE SIZE ANALYSIS

% Sand	37.5
% Silt	51.3
% Clay	11.2
Texture	Silt Loam

SOLUBLE CATIONS

Calcium	2.04 meq/l
Magnesium	0.71 meq/l
Sodium	0.51 meq/l

Sodium Adsorption Ratio 0.44

Munsell Color 10YR 6/3, Pale Brown

Rock Fragments	0.0 %	
Total Nitrogen	0.09 %	
Organic Carbon	2.4 %	
Carbonate	0.1 %	
Available Phosphorus	2.21	mg/Kg
Alkalinity	2.22	meq/liter

Available Water Capacity
5.0 (1/3)
4.4 (15)

INCORPORATED
EFFECTIVE:
JUL 30 1997 97B
UTAH DIVISION OIL, GAS AND MINING

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TEL: (801) 653-2311
FAX: (801) 653-2436

July 30, 1995

GENWAL COAL CO.
P.O. BOX 1201
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

Kind of sample reported to us ~~Coal~~ Soil

B2 Th1 #2
1 Bag

Sample taken at Genwal

Sample taken by Genwal

Date sampled June 26, 1995

Date received June 27, 1995

Analysis report no. 59-182262

SOIL ANALYSIS

pH	5.9 units
Conductivity	0.27 mmhos/cm
Saturation %	26.4

PARTICLE SIZE ANALYSIS

% Sand	53.8
% Silt	36.2
% Clay	10.0
Texture	Sandy Loam

SOLUBLE CATIONS

Calcium	1.43 meq/l
Magnesium	0.48 meq/l
Sodium	0.52 meq/l

Sodium Adsorption Ratio 0.53

Munsell Color 10YR 6/3, Pale Brown

Rock Fragments	0.6 %
Total Nitrogen	0.08 %
Organic Carbon	1.7 %
Carbonate	<0.1 %
Available Phosphorus	0.74 mg/Kg
Alkalinity	1.28 meq/liter

Available Water Capacity
4.9 (1/3)
3.9 (15)

INCORPORATED
EFFECTIVE:
JUL 30 1997 MB
UTAH DIVISION OIL, GAS AND MINING

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

Recommended For Your Protection
TERMS AND CONDITIONS ON REVERSE

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-8300 FAX: 708-953-9306
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July 30, 1995

GENWAL COAL CO.
P.O. BOX 1201
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

Kind of sample reported to us ~~Coal~~ Soil

C1 Th #2
1 Bag

Sample taken at Genwal

Sample taken by Genwal

Date sampled June 26, 1995

Date received June 27, 1995

Analysis report no. 59-182268

SOIL ANALYSIS

pH	6.2 units
Conductivity	0.24 mmhos/cm
Saturation %	25.4

PARTICLE SIZE ANALYSIS

% Sand	50.0
% Silt	34.0
% Clay	16.0
Texture	Loam

SOLUBLE CATIONS

Calcium	1.25 meq/l
Magnesium	0.76 meq/l
Sodium	1.14 meq/l

Sodium Adsorption Ratio 1.13

Rock Fragments	6.5 %	
Total Nitrogen	0.37 %	
Organic Carbon	2.6 %	
Carbonate	0.1 %	
Available Phosphorus	0.31	mg/Kg
Alkalinity	0.92	meq/liter

Available Water Capacity
7.1 (1/3)
4.9 (15)

Munsell Color 10YR 6/4, Light Yellowish Brown

INCORPORATED
EFFECTIVE:
JUL 30 1997 97B
UTAH DIVISION OIL, GAS AND MINING

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory