CHAPTER 2

SOILS
(R645-301-200)

TABLE OF CONTENTS
CRANDALL CANYON MINE, MINE AND RECLAMATION PLAN
CHAPTER 2
SOILS

SECTION	DESCRIPTION	PAGE
2.10	Introduction	2-1
2.20	Environmental Description	2-1
2.21	Prime Farmland Investigation	2-2
2.22	Soil Survey	2-2
2.23	Soil Characterization	2-4
2.24	Substitute Topsoil	2-4
2.30	Operation	2-4
2.31	General Requirements	2-4
2.32	Topsoil and Subsoil Removal	2-8
2.33	Topsoil Substitute and Supplements	2-8
2.34	Topsoil Storage	2-8
2.40	Reclamation Plan	2-9
2.41	General Requirements	2-9
2.42	Soil Redistribution	2-10
2.43	Soil Nutrients and Amendments	2-13
2.44	Soil Stabilization	2-14
2.50	Performance Standards	2-14
2.52	Stockpile Maintenance	2-14

CHAPTER 2

LIST OF PLATES

PLATE NUMBER	DESCRIPTION
PLATE 2-1	Soils Types Study Map
PLATE 2-2	Topsoil Storage Piles
PLATE 2-2A	Topsoil Storage Pile #3
PLATE 2-3	Topsoil Stockpile Locations
PLATE 2-4	Proposed Culvert Disturbed Area Soil Pit Locations
PLATE 2-5	Plan and Profile Proposed Topsoil Storage Pile #4
PLATE 2-5A	Proposed Topsoil Storage Pile #4 Cross-Sections
PLATE 2-5B	Proposed Topsoil Storage Pile #4 Cross-Sections
PLATE 2-6	Regional Soil Map

LIST OF APPENDICES

APPENDIX NUMBER	DESCRIPTION
APPENDIX 2-1	Negative Determination, Prime Farmland
APPENDIX 2-2	Negative Determination, Alluvial Valley Floor
APPENDIX 2-3	Soils Study
APPENDIX 2-3A	Soils
APPENDIX 2-3B	Supplemental Soils Inventory Proposed Culvert Expansion
APPENDIX 2-4	Rational and Justification for Redistribution of 6" Top Soil (Growth Media) for Final Reclamation
APPENDIX 2-5	Surface Facility Expansion - Topsoil Removal Report
APPENDIX 2-6	Soil Survey Report - Proposed Phase Two Expansion Area (South Portals) - James Nyenhuis
APPENDIX 2-7	Geotextile Properties

LIST OF APPENDICES

APPENDIX NUMBER	DESCRIPTION
APPENDIX 2-8	Laboratory Analysis, Native Fill and Imported Fill
APPENDIX 2-9	Letter Regarding Noxious Weeds in Fill
APPENDIX 2-10	Letter Regarding Prime Farmland

Note: Bold number plates and appendices are included with this submittal.

CHAPTER 2
LIST OF TABLES

TABLE NUMBER	DESCRIPTION	PAGE

No tables included in this chapter.

CHAPTER 2
LIST OF FIGURES

FIGURE NUMBER	DESCRIPTION
FIGURE 8A	Soil Depth of Interim Locations
FIGURE 8B	Soil Salvage Areas
FIGURE 8C	Soil Redistribution Areas
FIGURE 8D	Geotextile Areas

Note: Bold number figures and tables are included with this submittal.
Revised 4/05/2003

CHAPTER 2

SOILS

2.10 Introduction

This chapter presents soil resource data and soil mapping for the Crandall Canyon Mine. This information has been compiled from the previously approved Mine Reclamation Plan ACT/015/032 and newly gathered data associated with the approved culvert expansion. Additional soil information from the proposed south portals is also included. Soil studies were conducted in accordance with guidelines issued by the Utah Division of Oil, Gas, and Mining. All surveys fulfilled the requirements established by the Soil Conservation Service (SCS).

The permit area and coal leases are delineated on Plate 1-1. The disturbed area is presented on Plate 5-3. There will be no surface disturbance within the Incidental Boundary Change area. The area is being added to facilitate the extension of underground main entries and will not affect the ground surface or vegetation. There will be no surface disturbance within the South Crandall Lease area nor the U-68082 lease mod area as a result of mining within the lease.

This chapter presents a description of the premining soil resources, feasible use of substitute soils, topsoil and subsoil to be saved, stockpiling of soils, and surveys of the soils.

2.20 Environmental Description

The mine and existing area of disturbance is at an elevation of approximately 7500-7800 feet on a southern exposure with slopes ranging from 5% to 70%. The disturbance associated with the culvert expansionl include the canyon floor and the associated toeslopes. The mean annual soil temperature is 40 to 44 degrees F and the average annual precipitation is 20 to 23 inches.

The soils are classified as Entisols and Mollisols. The Entisols are shallow, found on the steeper slopes and have a moderate to high erosion hazard. The Entisols are classified as poor for the recoverability of topsoil due to the steepness of slope (50-70 percent) and the high percent of large rocks on and in the surface layer (35-60 percent). Recovery of topsoil from these areas is difficult.

The Mollisols are found on more moderate slopes and are deep, well drained soils which have a moderate to low erosion hazard. The Mollisols generally have a deep, well formed A horizon. These soils in general can produce large amounts of topsoil and subsoil that can be removed, stockpiled, and used as good growth medium for reclamation.

2.21 Prime Farmland Investigation

The land within the permit area has not been historically used as cropland nor is the area conducive to intensive agricultural uses. GENWAL contacted SCS in Salt Lake City and obtained a letter of negative determination enclosed as Appendix 2-1 from Mr. T.B. Hutchings Ph.D., SCS State Soil Scientist. There is no prime farmland within the South Crandall lease area nor the U-68082 lease mod area. (Refer to Appendix 2-10)

Also, information from the field survey completed by Valley Engineering was sent to SCS and a letter was received by GENWAL indicating a negative determination for the presence of an alluvial floor. The SCS letter is included with this application as Appendix 2-2. Both of these negative determinations are supported by the findings of Mr. Dean Larson, Soil Scientist with the Price Office of the U.S. Forest Service (Appendix 2-3A).

2.22 Soil Survey

The initial soil survey was conducted by Valley Engineering. Refer to Plate 2-1 for the existing surface disturbance. Accurate soil survey information and productivity data were obtained and are representative of the entire disturbed area (see Appendix 2-3 and Plate 2-1).

A supplemental soil survey was conducted by GENWAL personnel, Chris Hansen of Earthfax and David Steed of EIS in the summer of 1995 and 1996 to assess the undisturbed soils in the area of the culvert expansion project (Plate 2-4). These data have close correlation with and support the findings of the previous soil surveys.

2.22.2 Soil Identification

The "Soil Study" report prepared by Valley Engineering is included as Appendix 2-3 and the "Soil Types Study Map" is included as Plate 2-1. An additional soils study, prepared by the U.S. Forest Service, is included under Appendix 2-3A. The data collected for the approved culvert expansion project are contained in Appendix 2-3B. An additional soil study was prepared by James Nyenhuis for the south portal expansion (see Appendix 2-6). A map is included with this report.

2.22.3 Soil Description

Soil descriptions are found in the "Soil Study" report prepared by Valley Engineering included as Appendix 2-3 and on the "Soils Types Study Map" included as Plate 2-1. Refer to Plate 2-6 for the regional soil classification, including the soils within the South Crandall lease area.

Also, additional soil survey information can be found in Addendum to Appendix 3-2, Synopsis of Riparian Baseline Inventory of Crandall Creek and Review of Baseline Riparian Inventory of Crandall Creek Proposed Crandall Mine Expansion for a more thorough discussion on hydric soils.

Revised 4/05/2003

2.22.4 Present and Potential Productivity of Existing Soils

The present and potential productivity of soil within the disturbed area and the approved culvert expansion have been assessed to determine the volume of suitable growth materials and the difference between topsoil and subsoil. The following data have been supplied in Appendix 2-3 and 2-3B: sodium absorption ratio (SAR); electrical conductivity (ECE); saturation percentage; soluble calcium; magnesium and sodium; organic matter content; and lime content. Appendix 2-6 defines the productivity of the soils in the proposed south portal area.

The larger rock fragments encountered during topsoil salvage operations that could damage equipment during loading and transportation operations will be sorted out during salvage operations. Moderate-size fragments will be salvaged with the topsoil and stockpiled. The ECE values are very low in all samples as shown on page 8 of Appendix 2-3 and in Appendix 2-3B. There are no problems with salinity. The SAR values are also very low in all samples, indicating there are no problems with sodium salts, the pH is slightly alkaline which is normal for the area. All samples have some presence of carbonate.

On June 2, 1992, Mr. Larry Johnson and personnel from Environmental Industrial Service inventoried three areas that have interim reclamation. The areas in question are shown on Figure 8a and are listed as Areas 1, 2, and 3 respectively. The purpose of the inventory was to determine the depth of in-place soil and the success of the revegetation. The inventory also indicated that none of the reclaimed areas were topsoil storage sites.

Soil depths were determined utilizing a six foot probe driven into the ground on approximately 5 foot centers. At each test point, the probe was driven in three times in an area approximately 12 inches in diameter at a 90 degree angle to the surface and the depth of soil noted. The maximum depth encountered was then recorded and plotted.

A small portion of Area 1 had soil material to a depth of 24 inches. However, this soil was determined to be insitu soil that had not been disturbed due to its close proximity to an island of undisturbed vegetation. In addition to the reclaimed areas, the soil depths at the two undisturbed areas were also inventoried. Both areas average 39 inches of soil, but included approximately 50% cobble size rock (4 inches to 6 inches in diameter). Thus, this soil would yield less than 18 inches of usable top and subsoil if salvaged. Therefore, the net gain of soil to be utilized in other areas does not appear to justify the destruction of the existing established islands of mature vegetation.

Revised 4/05/2003

2.23 Soil Characterization

The soil survey was conducted in accordance with the standards of the National Cooperative Soil Survey and with the procedures set forth in the U.S. Department of Agriculture Handbook 436 (Soil Taxonomy, 1975) and 18 (Soil Survey Manual, 1951). In 1992 in conjunction with the acquisition of Lease UTU 68082 a new soils inventory was incorporated into the permit (Appendix 2-3A). In addition, supplemental soil data were collected for the proposed culvert expansion.

2.24 Substitute Topsoil

Topsoil and subsoil were removed in separate layers from all areas subject to surface disturbance except for map unit DPH2 (Plate 2-1). The removal of topsoil was restricted in areas with steep slopes of 30% and greater and in areas with a high percent of large rocks present in the soil profile. The subsoil from the JDE map unit (Plate 2-1) will be used as a topsoil substitute for reclamation of the steep rocky slopes associated with the DPH2 soils. The acreage of DPH2 soils to be reclaimed is 2.39 acres.

2.30 Operation

2.31 General Requirements

2.31.1 Methods for Removal and Storage

All topsoil and subsoil were removed during the construction season of 1982. Actual procedures are not known. Based on the data available, the following suppositions are provided.

The subsoil and topsoil were not stockpiled separately. Topsoil and subsoil were removed in one lift with the depth of topsoil determined by the operator who monitored the soil color. The lift depth varied as shown within the "soil study" report, Appendix 2-1. Topsoil and subsoil were removed and stored in the permanent stockpile location as shown on Plate 2-2. (The four stockpiles located on Plate 2-2 are within the permit area and the disturbed boundary).

The topsoil was removed from the areas indicated on the soil survey map (Plate 2-1) as TCE and JDE, which included the Datino Variant, Jodero Variant and Twin Creek soils, after the vegetative cover was cleared from the areas. A front end loader and a D-6 size dozer were used to remove and load topsoil into haul trucks. A qualified supervisor monitored the topsoil removal and stockpiling operation to insure the protection and preservation of all topsoil material. Each topsoil stockpile was worked with a small Cat D-6 size track dozer to minimize compaction to the stockpile while dressing the stockpile to final design configuration.

The topsoil stockpiles are adjacent to the public access road, as requested by the USFS. The annual and perennial plants that were used to stabilize the topsoil stockpiles for interim reclamation are contained in the seed mixture described in Section 3.30 of Chapter 3.

The topsoil piles were inventoried to attempt to determine the disposition of distribution of topsoil and subsoil. All three storage areas appeared to be made up of similar material with no distinct change in color and/or texture which might distinguish subsoil or topsoil placement. The inventory consisted of minor probing and ocular estimates of the surface only. Due to the well established vegetation and the stability of the piles of soil, a more extensive inventory would serve no purpose other than to damage the integrity of the storage sites.

The pedogenic process will become somewhat restricted for the soils stored in the topsoil stockpiles. The physio-chemical changes that may occur include nitrogen loss, loss of micro biological life forms, the existence of anaerobic conditions within the deeper portions of the stockpiles, and structural breakdown of the soils. These changes will be minimized by avoiding compaction during stockpile construction and by segregating the individual soil units where practical.

Topsoil from the culvert expansion area was salvaged from the area south of the warehouse identified as the north slope area (Map Unit A), the south slope bench area (Map Unit B), and the south slope of the hillside adjacent to the coal pile area (Map Unit C) as shown on Figure 8B. Two additional new areas, shown as Map Unit D and Map Unit E on Figure 8B, were identified for topsoil salvage, during pad construction, in the southwest corner of the mine yard expansion area. Immediately east and contiguous to Unit D is a rocky point that was recontoured during the yard expansion. This area is identified as Map Unit E. Topsoil was removed from this point but because this work was done after most of the topsoil recovery was finished, this volume of material was not included in the soil report prepared by Pat Johnston, the soil consultant who supervised and monitored the topsoil recovery and stockpiling operations during the yard expansion operations. Nielson Construction Project Manager Mark Greenhaulgh oversaw the topsoil removal and stockpiling from this particular area. Approximately 108 cubic yards of topsoil was removed and stockpiled at stockpile #4 from this nose cut area.

Soil was also removed, during the surface expansion project, from two areas, designated as Map Unit G, during the construction project. This soil was collected from a narrow strip along the south side of the road and old loadout site and from the new area that was disturbed when the sediment pond was reconstructed. Approximately 160 cubic yards of topsoil material was removed from these two areas and stockpiled.

No topsoil or substitute topsoil materials was salvaged from the area associated with the stream or streambank or the area of steep slope area on the southern flank of the stream. To preserve the alluvial and residual soils and stream channel in this area, GENWAL covered the insitu stream area with a geotextile fabric prior to placing any backfill during construction. Similarly on the steep slope area to the south of the stream bank a geotextile fabric was placed on the surface before placing any backfill material. During the culvert expansion approximately 2.5 acres of in place topsoil were protected using the geotextile (see Figure 8D). A description of the geotextile used is given in Appendix 2-7. During the south portal construction an additional 0.08 acres of in place topsoil will be protected with geotextile.
Revised 4/05/2003

After the lower pad of the Expansion Area was completed to finish grade, the permanent coal storage area was prepared. Topsoil material was removed from Map Unit C (Figure 8B), a small area of the adjacent slope near the location where the southern flank of the coalpile rests against the existing hillside. This topsoil was salvaged under the direction of Pat Johnston, soil scientist, to assure optimum recovery of the soil resource in this area. The soil was stockpiled at topsoil stockpile #4 for storage until it is utilized during final reclamation. Between all salvage areas, about 3,880 cubic yards of topsoil was collected and stockpiled at stockpile #4 for final reclamation. This amount exceeded the original projection of 3,480 cubic yards by 400 cubic yards.

During coal storage and stockpiling activities, coal was pushed up beyond area C onto an area where topsoil had not been stripped. In order to abate violations N98-45-1-1 and N98-45-3-1, GENWAL has removed the coal from the area where topsoil had not been removed on the south slope. (The approximate area is identified as Map Unit F on Figure 8B.) The previously undisturbed topsoil area, which had been covered with coal, was cleaned thoroughly using the best technology available. The topsoil was then removed under the supervision of Pat Johnston, reclamation specialist/soil scientist between August 5- August 18, 1998 and transported to topsoil stockpile #4. The topsoil was removed from the slope area that was and could potentially be affected by the coal stockpile in the future. Approximately 690 cubic yards (69 truck loads) was salvaged from the slope. The visible topsoil depth averaged 3-4 inches over this area but 8-9 inches was actually removed due to the steepness of the slope and the operational constraints of the equipment on the steep slope.

During phase 2 of the surface expansion, three portals will be established on the south slope of the mine yard. The new portals will be constructed along the south side of the upper pad of the existing mine-yard (refer to Plate 5-3). This area is presently serving as the parking lot and material storage yard. The new portals will consist of an intake portal, a fan portal, and a belt portal. The intake portal will be used to accommodate fresh air intake into the mine, and also to provide primary travel access into the mine for employees and materials. The fan portal will support a ventilation fan which will suck return ventilation air out of the mine. The belt entry will be located south of the existing coal pile and will contain the main conveyor belt hauling coal out of the mine.

Construction of the portals will be done within the existing permitted disturbed area boundary. The existing disturbed area boundary will not be increased. The existing sediment pond has been sized to accommodate this new portal construction area, so no changes to the sediment pond

Revised 4/05/2003

will be required. Except for adding a new culvert under the access ramp to the new portal, none of the previously approved and existing surface drainage structures will be affected.

In the area of the new south portals, the base of the coal seam is located approximately 17' above (i.e., higher than) the level of the existing mine-yard. An earthen ramp will be constructed on the existing pad to gain access up to the level of the coal seam. In the area of the intake and fan portals, the existing hill slope will be excavated with a back-hoe to expose the coal seam in preparation for construction of the portal canopies. A small elevated pad will also be constructed in front of the fan portal on which the mine fan can later be installed. This fan pad will be constructed as a continuation of the access ramp leading to the intake portal. The access ramp to the intake portal and the fan pad will be constructed partially using the earthen material generated in the process of facing up the coal seam and partially using fill material hauled in from an off-site borrow source. (See Appendix 2-8 for laboratory analysis of the native fill and the imported fill) The imported fill material will come from the same source (i.e., the same borrow pit) that supplied the pad material for the recently completed surface expansion. This borrow site would be the Nielson Construction commercial borrow pit located in Huntington Canyon below the power plant. The source of fill material has been determined to be free of noxious weeds (see Appendix 2-9). As the access ramp is being constructed a new culvert (C-11A) will be added to handle sheet flow drainage from the upper material yard (see Plate 7-5). It is estimated that approximately 3500 cubic yards of fill will be needed to construct the access ramp/fan pad. This quantity will be verified after construction on the as-built plans.

As the access ramp and fan pad are constructed from the existing yard surface up to the level of the coal seam outcrop, some of the new fill material will be placed up against the intervening existing undisturbed slope. Part of the access ramp/fan pad will therefore be constructed on top of the existing slope. Before this ramp/pad is constructed, topsoil along the existing slope below the fan pad and access ramp will be protected in-place using a geotextile cover placed along the undisturbed slope under the fill material. This topsoil protection technique would be identical to the approved method used during construction of the existing surface expansion facilities (Phase I surface expansion). It is estimated that approximately 3366 square feet (0.08 acres) of in place soil will be protected by geotextile during construction of the south portals. A description of the geotextile to be used is given in Appendix 2-7.

After the access ramp and fan pad have been constructed (and the underlying in-place topsoil protected with geotextile), the portal excavation can begin. Prior to starting the portal cuts, the existing topsoil at the portal sites will first be salvaged. Topsoil conditions along the south slope portal area is similar to the conditions at the adjacent coal pile area where topsoil was salvaged during August, 1998. This topsoil salvage effort is described in appendix 2-5, Part II, prepared by Pat Johnson, soil scientist. At that area, according to Ms. Johnson's report, the depth of true topsoil was 3" but an average of 8" - 9" of material was taken due to the operating nature of the backhoes which were employed in the salvage process. In addition, an intensive soil inventory and site investigation was performed on the south slope on August 18, 1998 and is included in Appendix 2-6.

In order to minimize the area of additional disturbance associated with the construction of the south portals these portals will be constructed by excavating individual pockets into the hillside for each portal rather than along a common highwall. By utilizing individual pocket cuts for the portals the total area of new disturbance is expected to be less than 4500 sq. ft. (0.11 acres). Topsoil will be removed from the areas of the south portal pocket cuts prior to excavation as described in Section 2.31.1. According to the Nyenhuis survey, the upper 2 feet (24 inches) is suitable for salvage. Based on the Nyenhuis soil survey it is anticipated that approximately 9000 cu. ft. (333 yds.) of topsoil will be salvaged from the intake and fan portal cuts.

The salvaged topsoil will be stored on the existing topsoil pile #4 located off-site at the bottom of Crandall Canyon. This topsoil pile is constructed on Forest Service land under a Special Use Permit issued on 8/17/87. This pile #4 was originally constructed in 1997 curing Phase 1 of the surface facility expansion. At that time it was designed and constructed sufficiently large to accommodate the additional topsoil storage requirements for the Phase 2 south portal construction. The Forest Service has concurred with the addition of the south portal topsoil to this pile. All topsoil removal, salvage and storage will be over-seen, directed and monitored by an independent soils scientist approved by the Division. A report of the topsoil salvage operation will be prepared by the soil scientist and added to the MRP upon completion as Appendix 2-5, Part III.

After the portal sites have been faced up construction of the portal canopies will begin. These canopies will be constructed from steel I-beams and plate according the MSHA guidelines. The canopies will be anchored to concrete footers. These canopies will provide a safe structure from which the miners can begin driving the entries back into the coal seam. After the intake and fan entries have been driven into the hillside and connected together underground with a cross-cut, work can then be started on construction of the mine fan installation. While the fan is being installed, the miners will drive the belt entry from inside the mine out to the belt portal. During this phase of development, mined coal will be moved away from the surface with a front-end loader, a mobile radial stacker, or some other temporary means of conveyance. After the belt portal connection is completed, a new conveyor truss will be installed from a concrete landing at the belt portal out to the existing coal pile. All coal from the mine will then be delivered directly to the existing coal pile and will be crushed and loaded on trucks through the existing coal handling facilities.

Power, water, communications, and other mine infrastructure will be supplied to the south portals as an extension of the pre-existing Crandall Canyon Mine facilities.

Figure 5-11 depicts a typical cross-section through the south portals, showing the pocket cut, access ramp, lu-situ soil geotextile protection, and the portal canopy construction.

Plate 5-3 depicts that area of the south slope where the portals are proposed to be located during phase 2 expansion in mid-1999. Plate 5-3 also shows the cut slope disturbance in the southwest portion of the mine yard. The topography for this portion of the mine yard has been revised to reflect the as-built configuration. A side canyon drainage channel conveying undisturbed area runoff to the main Crandall Creek channel forms the western boundary of the mine yard in this area. Rip rap for the culvert inlet headwall was installed on both sides of the channel farther up the embankments than depicted on the proposed construction map. This additional rip rap was added
Revised 4/05/2003

to protect the main culvert inlet from erosion due to the side canyon drainage. Rip rap was added to the side channel to increase the integrity of the channel and to prevent the channel embankment from eroding thus allowing undisturbed drainage to enter the mine yard area. The same rip rap specifications used for the main undisturbed drainage inlet culvert and headwall were also used for armoring the side channel.

GENWAL is also considering a second possible option for constructing the south portal intake and fan portals. Instead of constructing a ramp up to the level of the coal seam, short tunnels would be driven from the existing yard level up to the coal seam. In this scenario the pocket cuts would be be made into the hillside lower down at the same level as the existing pad. This level is approximately 15' below the base of the coal seam. Since the coal seam sits directly on top of the Star Point Sandstone, this sandstone out-crops at the existing yard level. Tunneling would begin in the sandstone and ramp up underground to the coal seam.

If the tunnels are driven at an incline of 10% they will be about 160' long to where they intersect the base of the coal seam. At 8' high and 20' wide, excavation of the two tunnels (intake and fan) would generate approximately 1900 cu yds. of material during construction. This tunnel excavation material will consist of sandstone mixed with coal. This excess material would be disposed of by placing it in a 6' deep layer along the existing fill bank located between the upper material yard and the coal storage pad. This embankment is part of the designated coal storage area and currently is covered with coal. Therefore, after the tunnel excavation material is layered onto the embankment, it too will be covered over by the active coal pile for the remaining life of the mine. Refer to Figure 13-a and 5-13b for more details of this tunneling construction option.

Upon final reclamation the tunnel excavation material would be hauled back into the mine tunnels where it would be sealed up prior to backfilling the portals. Backfilling and reclamation of the portal pocket cuts would be the same regardless of whether the ramp or tunnel option is selected. If GENWAL elects the tunnel construction option, topsoil will be salvaged in exactly the same manner as described previously. The amount of topsoil salvaged, stored and redistributed would be the same regardless. If the tunnel option is selected, there would be no additional in-place topsoil required to be protected with geotextile, because there would be no fill material placed up against the hillside.

If this option is selected, GENWAL commits to ensuring the protection of the hydrologic balance for surface and groundwater systems as required by R645-301-731. The tunnel excavation material will be tested for acid- and toxic-forming material and the analytical results of this testing will be presented to the Division. The hydrologic balance will be protected in the following manner.

a) The excavation material will consist of fragmented Star Point sandstone. This sandstone

outcrops naturally in the minesite area and is one of the major geological features which determine the character of Crandall Canyon and many other canyons in the Wasatch Plateau. This predominant sandstone is not known to be acid- or toxic-forming anywhere in the Utah coalfields. However, further site-specific testing of the sandstone will be conducted prior to any construction.

b) The proposed location of the material storage is on top of the existing pad fill. Any runoff from this area would report to the existing sediment pond.

c) The existing pad fill in the proposed storage area varies between 10' and 40' thick over the bypass culvert and is densely compacted. This thickness of compacted fill material is sufficient to preclude any leaching downward into the bypass culvert or groundwater.

2.31.2 Analysis of Topsoil Substitute

The soil survey and chemical analysis for the proposed topsoil substitute have been completed. A portion of the B horizon of the TCE soil was salvaged and stockpiled along with that from the JDE to insure that an adequate supply of plant growth medium will be available for reclamation of the steep slopes (50 to 70 percent).

2.31.3 Topsoil Evaluation

Testing plans for evaluating the results of topsoil handling are discussed within Section 2.42 of this chapter. Nutrient and soil amendments will be added based on the results of these tests. Sampling techniques are discussed in Section 2.41.

Five years prior to beginning reclamation operations, GENWAL will consult with the Division to re-evaluate the techniques and practices being proposed in the reclamation plan (Appendix 5-22). This consultation will include forming a task force of members with various areas of reclamation expertise to review the reclamation plan and recommend the best and most suitable reclamation techniques and products available at that time. The review and consultation will re-assess and revise, where needed, the existing reclamation plan to provide the best and most appropriate reclamation measures for the site.

2.31.4 Stockpiles

The volume of each stockpile is included on Plates 2-2, 2-2a and 2-5 as well as in Section 2.42 of this application. See Appendix 2-4 for the justification and rationale for 6" topsoil redistribution.

The topsoil stockpiles are protected from erosion, compaction, and contamination. An earthen berm and asphalt berm in combination with strawbale dikes have been constructed to protect against topsoil loss and the stockpiles have been revegetated with an approved vegetative cover.

The cross sectional views of the topsoil and subsoil stockpiles are included on Plates 2-2, 2-2A, 2-3, 2-5, 2-5A and 2-5B. Stockpile #4 will be used for the salvaged materials from the culvert expansion area, and the design is shown on Plates 2-5, 2-5A and 2-5B. GENWAL has submitted Plate 2-3 showing the location of the topsoil stockpiles with respect to the surface facilities. Topsoil identification and protection markers are installed. The perimeter and topsoil markers conform to UDOGM regulations.

Stockpile #4 will be constructed with topsoil removed from the surface expansion project. The stockpile will be located across the road and north of stockpile #3. This location was previously surveyed for cultural resources by Forest Service archeologist, Barbara Blackshear. No cultural resources were located. Soil survey information for this area is presented in Appendix 2-3A.

The pile area will accomodate approximately 5,000 cubic yards of soil material with sideslopes on a 3:1 slope and a top elevation of 6,997'. Approximately 4,756 cubic yards of material were salvaged from the surface expansion area. Approximately 333 cubic yards of additional material is expected to be salvaged from the south portals. Refer to Plates 2-5, 2-5A and 2-5B for design detail. These plates will be updated in the MRP to reflect the as-built configuration after construction of the south portals is complete.

The topsoil and substitute topsoil materials are stored in Stockpile #4 and will be protected from erosion by a vegetative cover. Upon placement and configuration of the topsoil stockpile, two tons per acre of organic mulch and an approved seed mix was applied at the specified rate approved by the Division. The mulch and seed was applied to the topsoil stockpile in the early fall of 1997. Silt fence was placed around the perimeter of the pile.

2.32 Topsoil and Subsoil Removal

All topsoil and subsoil, associated with the initial disturbance, were removed during the construction season of 1982. The volumes of salvaged topsoil and subsoil, included in Section 2.42, is 9,219 bank cubic yards. The topsoil was stored in four locations as shown on Plates 2-2, 2-2a, 2-3, and 2-5. The topsoil associated with the proposed culvert expansion will be removed and stockpiled according to approved plans. Areas showing soil removal are shown on Plate 2-4 and Figure 8B; and the stockpile area is shown on Plates 2-3 and 2-5.

2.33 Topsoil Substitute and Supplements

Section 2.24 and 2.42 of this chapter address the substitute topsoil soils and their perspective locations.

2.34 Topsoil Storage

All topsoil and subsoil from the initial disturbed area were removed and stored during the construction season of 1982. The volumes of salvaged topsoil and subsoil are included in Section 2.42 of this chapter. The topsoil was stored in four locations as shown on Plates 2-2, 2-2a, 2-3, and 2-5. Sections 2.31 and 2.42 of this chapter address the topsoil storage and location of the topsoil piles.

Revised 4/05/2003

2.40 Reclamation Plan

2.41 General Requirements

The permit application includes plans for redistribution of soils, use of soil nutrients and amendments and stabilization of the redistributed soils.

2.42 Soil Redistribution

The soil redistribution volumes are presented in the table below for the 13.6 acre surface facility site and 1.40 acre topsoil stockpile areas. (Refer to Figure 8C.)

AREA IDENTIFICATION	ACREAGE	DEPTH	VOLUME
Original Surface Facilities Area			
Portal Area	0.90 acres	12"	1,452 CY
Shop Area	1.09 acres	12"	1,759 CY
Old Substation Area	0.40 acres	12"	645 CY
Old Loadout Area	2.11 acres	12"	3,404 CY
Subtotal	4.50 acres	12"	7,260 CY
Expansion Area			
North Slope Area	0.14 acres	16"	300 CY
S. Slope Bench Area	0.49 acres	16"	1,051 CY
Coal Pile Area	0.41 acres	12"	662 CY
SW corner of mine yard	0.28 acres	12"	452 CY
Nose cut area	0.11 acres	12"	178 CY
Upper coal pile area	0.15 acres	12"	242 CY
Loadout/pond area	0.22 acres	12"	355 CY
South Portals	0.11 acres	16"	236 CY
Subtotal	1.91 acres	12"/16"	3,477 CY
Total Topsoiled Area	6.41 acres		10,737 CY

Areas Not Topsoiled

Forest Service Road	0.53 acres
Forest Service Trail Head	0.30 acres
Topsoil Storage Areas	1.40 acres
Interim Reclamation Areas	0.78 acres
Undisturbed Areas - N. Side	0.48 acres
Unaffected Area Culvert Inlet	0.50 acres
South Slope Area	2.50 acres
Undisturb. South Area	1.89 acres
Area East of Old Loadout	0.22 acres
Subtotal	8.60 acres
TOTAL AREA	**15.01 acres**

Revised 4/05/2003

The 1.40 acres comprising the four topsoil/subsoil locations will not require soil redistribution since the native topsoil is still in place. The USFS access road and trailhead area will be left intact removing an additional 1.47 acres from reclamation requirements. On the south slope of the Expansion Area, where the fill will be placed to create the coal stockpile yard, the topsoil has been left inplace and protected by geotextile fabric. This area will not have any additional soil material placed on it during final reclamation. Topsoil material recovered from this area will instead be dedicated to reclaiming the original mine yard area and area adjacent to the road. On the south slope area adjacent to the permanent coal storage area, topsoil will be removed from a small area of the adjacent slope near the location of the future stacking tube where the southern flank of the coalpile will rest against the existing hillside. This topsoil will be salvaged under the direction of a soils scientist to assure optimum recovery of the soil resource in this area. The soil will be stockpiled off-site at an approved storage location until it is re-used during final reclamation.

The topsoil requirements will be met from the following areas:

SOIL	ACREAGE	VOLUME	DEPTH
Stockpile 1 (JDE & TCE)	0.20	943 cy	NA
Stockpile 2 (JDE & TCE)	0.20	1087 cy	NA
Stockpile 3 (JDE & TCE)	0.50	3709 cy	NA
Stockpile 4 (Additional)	0.50	2052 cy	NA
Stockpile 4 from coal storage area, Summer 1997 (Areas A, B, C, D, E & G)		4,066 cy	
From coal storage area, August 1998 (Area F)		690 cy	
From South Portals		333 cy	
From Forest Service Trailhead		32 cy	
TOTAL		**12,912 cy (previously 9,519)**	

The subsoil material has been chemically and physically analyzed, to allow for the suitability determination as a plant growing media (Appendix 2-3). The subsoil was removed from the JDE and TCE areas outlined on Plate 2-1 (see Plate 5-3 for surface facilities).

Topsoil and subsoil of the JDE soil type are stored at the above referenced four locations (Plates 2-2, 2-2a and 2-3). Topsoil stockpiles are a mixture of soil types JDE and TCE. The soil types were not segregated during placement in the existing topsoil stockpiles. Topsoil piles will be maintained in their present location and condition until approval is received from the Division for redistribution.

Topsoil will be redistributed with a small, tracked, front-end loader and a D-6 (or smaller) size dozer or a backhoe. The disturbed areas will be ripped prior to topsoil redistribution. A qualified supervisor will monitor the topsoil redistribution operation. The monitoring will ensure even distribution of the topsoil. To minimize compaction of the topsoil, after redistribution, the topsoil will be disced and/or harrowed on the contour where slopes safely allow. Any reclaimed areas that exhibit rills and gullies in excess of six inches will be regraded and seeded.

In that area where the entire soil horizon has been covered with geotextile fabric, the fill material will be removed in 5-10 foot lifts exposing the marker soil and geotextile fabric on an increment of the south slope. After the marker soil has been carefully removed, the geotextile fabric will be peeled away from the surface of the slope. The soil will then be sampled randomly to determine what amendments might be needed. Soil amendments such as fertilizer or PAM (polyacrlimide) would be applied. After the appropriate amendments have been added, the surface would be broadcast seeded. The seed would be hand raked into the soil surface. A wood fiber mulch would then be sprayed over the seeded soil surface. Bonded fiber tackifier will be sprayed over the mulch to hold it in place. Reclaiming the south slope in 5-10' vertical increments, as the yard fill is being removed, will allow better access to the slope for hand work such as seeding, raking and mulching and also minimize soil disturbance and exposure to erosion.

If possible, the topsoil will be redistributed in the late fall (late September or early October) just prior to the seeding time which will provide a seedbed free of weeds and annual grasses. Any weeds and annual grasses which become established before seeding, will be removed before seeding is attempted. Seeding will be done as soon as possible after the seedbed is prepared, but not prior to October lst. If seeding cannot be done within 30 days of topsoil redistribution, the Division will be notified.

No borrow areas will be required to supplement the volume of topsoil or substitute topsoil for redistribution. Due to the limited space within the disturbed area, the subsoil, which will serve as a topsoil substitute, has been stored in topsoil stockpiles as shown on Plate 2-3.

No terracing will be done. All final grading and preparation of overburden before replacement of topsoil will be done along the contour to minimize erosion and instability. See Chapter 5, Section 5.40 for further information.

Initial data indicated that the coal may have had an acid forming potential. However, more recent data (overburden and underburden samples from three in-mine locations and coal channel samples from three in-mine locations) indicate that the material is neither acid-forming or toxic. The chemical analysis of the coal and overburden may be found in Appendix 6-2. The applicant has provided the results of chemical analysis for overburden (soils) on pages 8 and 10 in Appendix 2-3. Accumulated waste from the sediment pond will be analyzed for the acid and toxic forming constituents as defined in Section 5.28.30, prior to either onsite or offsite disposal.

All coal will be removed from the site as saleable product prior to reclamation. The toxicity of the material below the coal stockpile will be tested prior to soil redistribution and treated as necessary. No underground waste will be stored on the surface which would require a plan to be submitted for treating an acid and/or toxic material.

Postmining topographic views of the disturbed area are shown on Plates 5-16 and 5-17. The contour map shows the final surface configuration of the permit area which can be used in conjunction with the premining surface configuration map.

Recontouring

All areas affected by surface operations will be graded and restored to a contour that is compatible with the natural surroundings and post mining land use. For approximate contours prior to surface disturbance refer to the maps presented as Plates 3-7, 3-8, and 3-9.

Removal or Reduction of Highwall

See Chapter 5, Engineering, Section 5.40, Reclamation Plan.

2.43 Soil Nutrients and Amendments

GENWAL has committed to adding nutrients as determined by lab analysis conducted on topsoil samples after redistribution and during final reclamation. The methods used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile used for lab analysis are presented below. Amendments will be added to the soil according to "Soil Survey" recommendations (See Appendix 2-3).

Two soil samples per acre of redistributed topsoil will be submitted to the lab for assessment of nutrient requirements. All lab work will be conducted by a qualified laboratory using methods approved by the Division. The samples will be collected by auger with each auger sample taken on the correct angle to the slope. Results of the samples, along with consultation from the regulatory authority, will determine the necessary nutrients and amendments to the topsoil.

Nutrients and soil amendments, if shown to be required by soil tests shall be applied to the redistributed topsoil layer by broadcast methods and tilled into the topsoil (if required). One ton per acre of alfalfa or straw mulch will be incorporated into the redistributed topsoil and substitute topsoil for increased fertility and physical structure enhancement (separate and distinct from the wood fiber mulch used as a surface mulch described in Section 2.44). No other mitigation plans are proposed for the soil resources except for the addition of nutrients to the topsoil and subsoil after redistribution during the reclamation process.

2.44 Soil Stabilization

Before the topsoil is redistributed, the area to receive topsoil will be regraded and ripped to ensure positive contact and minimize slippage between the existing surface and the redistributed topsoil. The regraded area will be disced on slopes of less than 20% and scarified with a trackhoe on slopes greater than 20% until the grade becomes impractical for the equipment to operate. Topsoil will be redistributed in a manner that achieves an approximate, uniform stable thickness on a surface that will prevent excess compaction of the topsoil. The topsoil will be protected from wind and water erosion before and after it is reseeded. It is proposed that the topsoil will be redistributed with a front end loader and D-6 size dozer. Surface roughening techniques, such as gouging or deep pocking, will be used on the soil surface to minimize compaction and promote water harvest and conservation.

On slopes of 30% and less a wood fiber mulch of 1.5 tons per acre will be used which will be bonded with the soil using a tackifying agent. However, the steeper slopes south of Crandall Creek will treated with a PAM chemical soil treatment to enhance moisture retention and relieve compaction. Then, the seed would be broadcast and hand raked into the soil surface. A soil innoculation treatment may also be incorporated into the soil to aid the re-establishment of soil bacteria, microhorizia and mycelium. Wood fiber mulch will be sprayed over the seed bed and then a bonded fiber matrix tackifier will be applied.

2.50 Performance Standards

All topsoil, subsoil and topsoil substitutes or supplements will be removed, maintained and redistributed according to the plan given under R645-301-230 and R645-301-240.

2.52 Stockpile Maintenance

All stockpiled topsoil, subsoil and topsoil substitutes or supplements will be located, maintained and redistributed according to plans given under R645-301-230 and R645-301-240. Stockpiled topsoil will be protected through a combination of berms, vegetative cover, strawbale dikes and/or silt fences. In addition, those piles adjacent to the main access road that could be impacted by salt used in ice removal will be closely monitored to determine if the vegetation is adversely impacted. In the event damage is in evidence, salt use will be suspended in those areas adjacent to topsoil piles.

CHAPTER 2

FIGURES

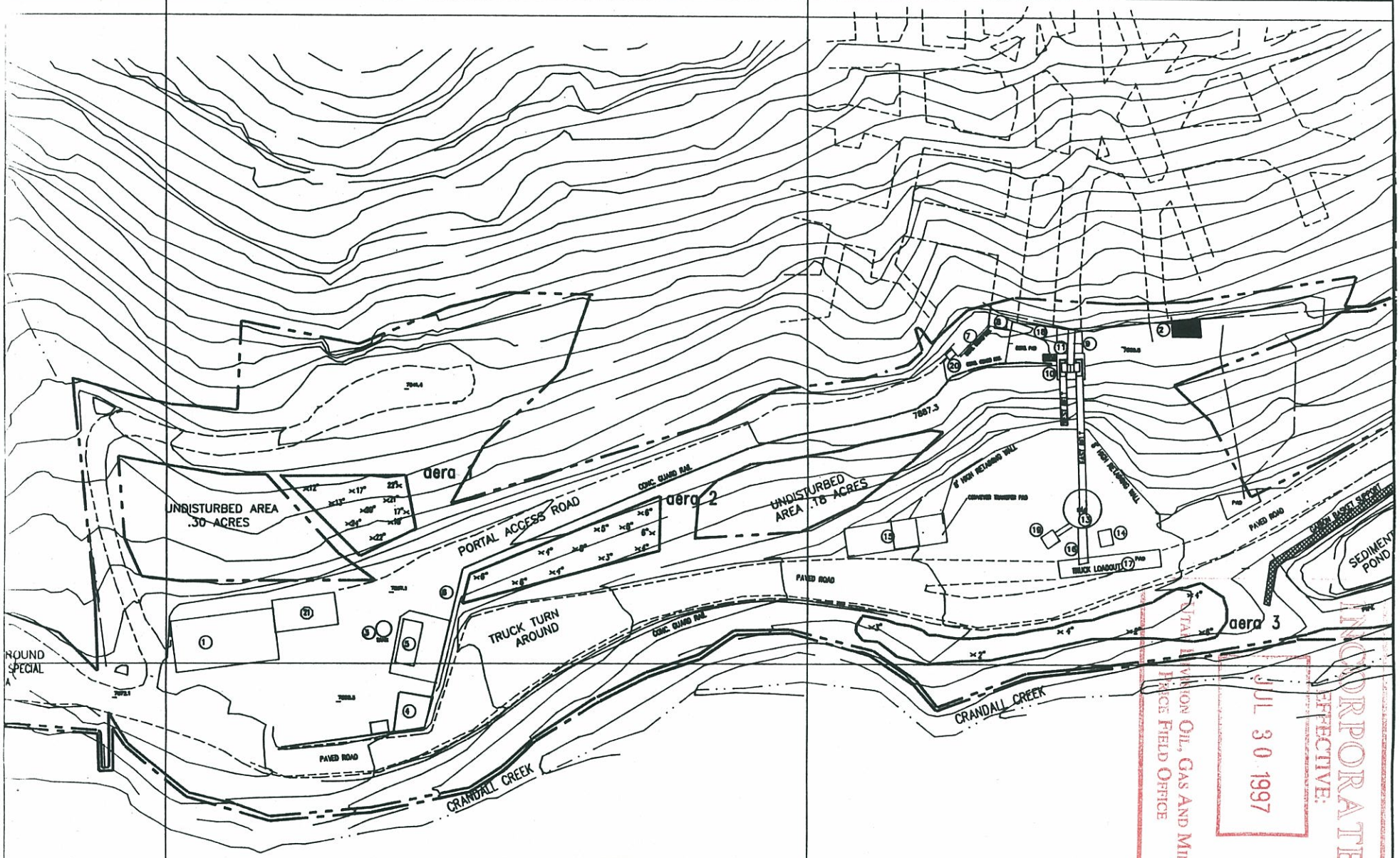
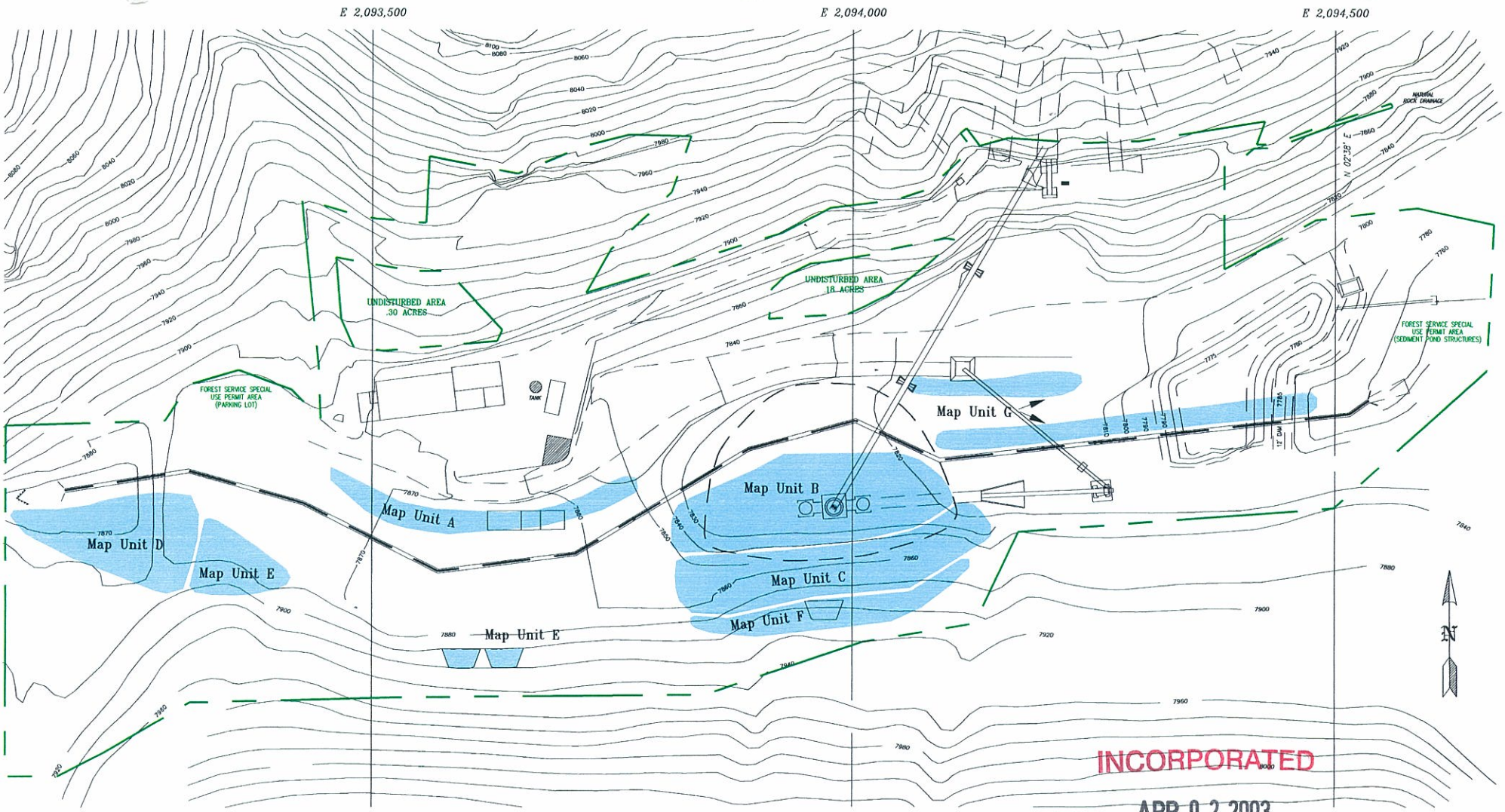


FIG. 8A

SOIL DEPTH FROM INTERIM RECLAMATION LOCATIONS

DATE : 6-15-92



SOIL SALVAGE AREAS

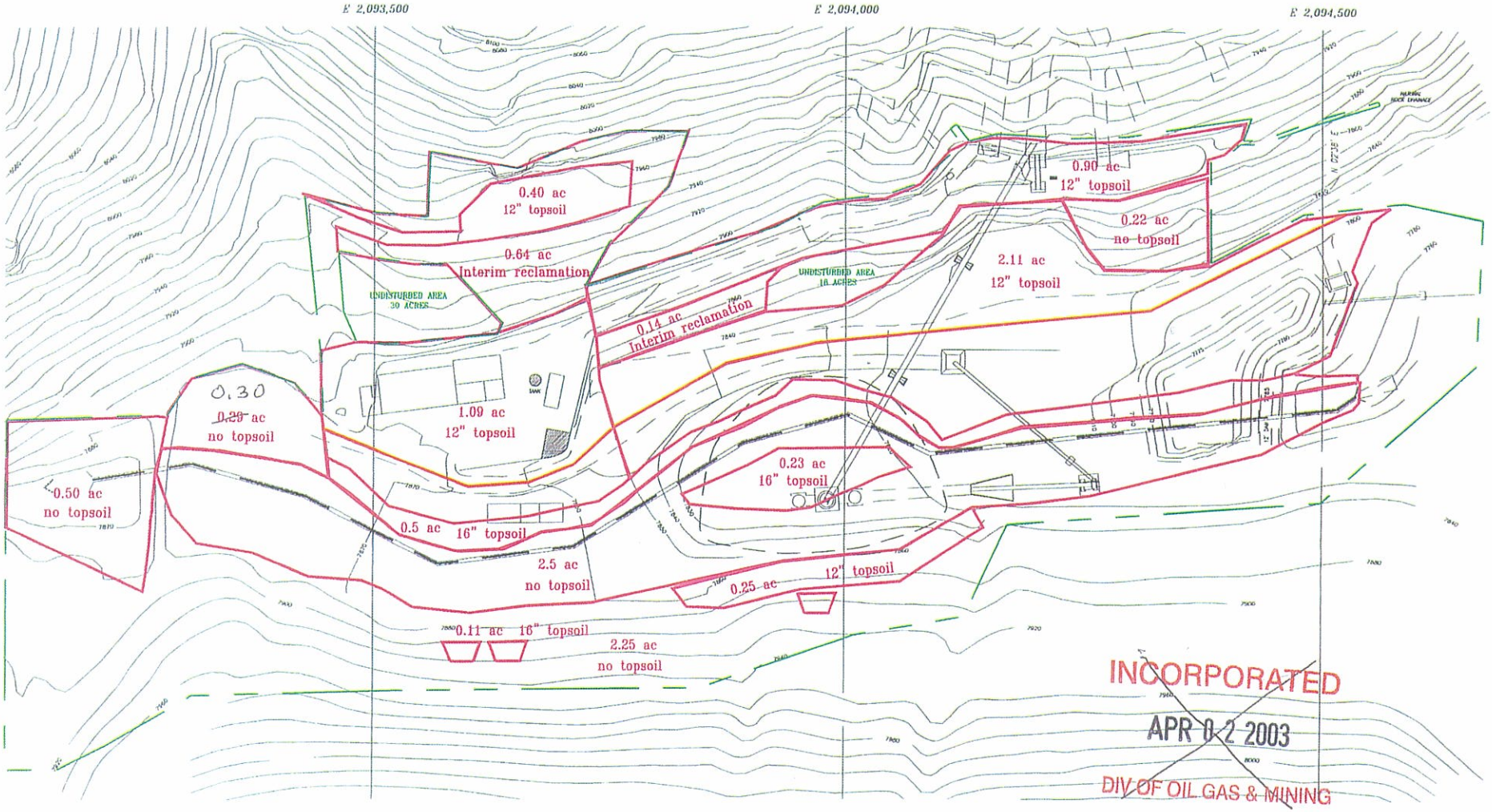
		Acreage	Volume
Map Unit A	(N. Slope Area)	0.14 ac	180 yd.3
Map Unit B	(S. Slope Bench Area)	0.49 ac	1,728 yd.3
Map Unit C	(Coal Pile Area)	0.41 ac	
Map Unit D	(SW corner of mine yard)	0.28 ac	1,872 yd.3
Map Unit E	(Nose cut area/south portals)	0.22 ac	441 yd.3
Map Unit F	(coal pile area)	0.15 ac	690 yd.3
Map Unit G	(loadout/pond area)	0.22 ac	178 yd.3

02/20/03

FIGURE 8B SOIL SALVAGE AREAS

Scale: 1" = 150'

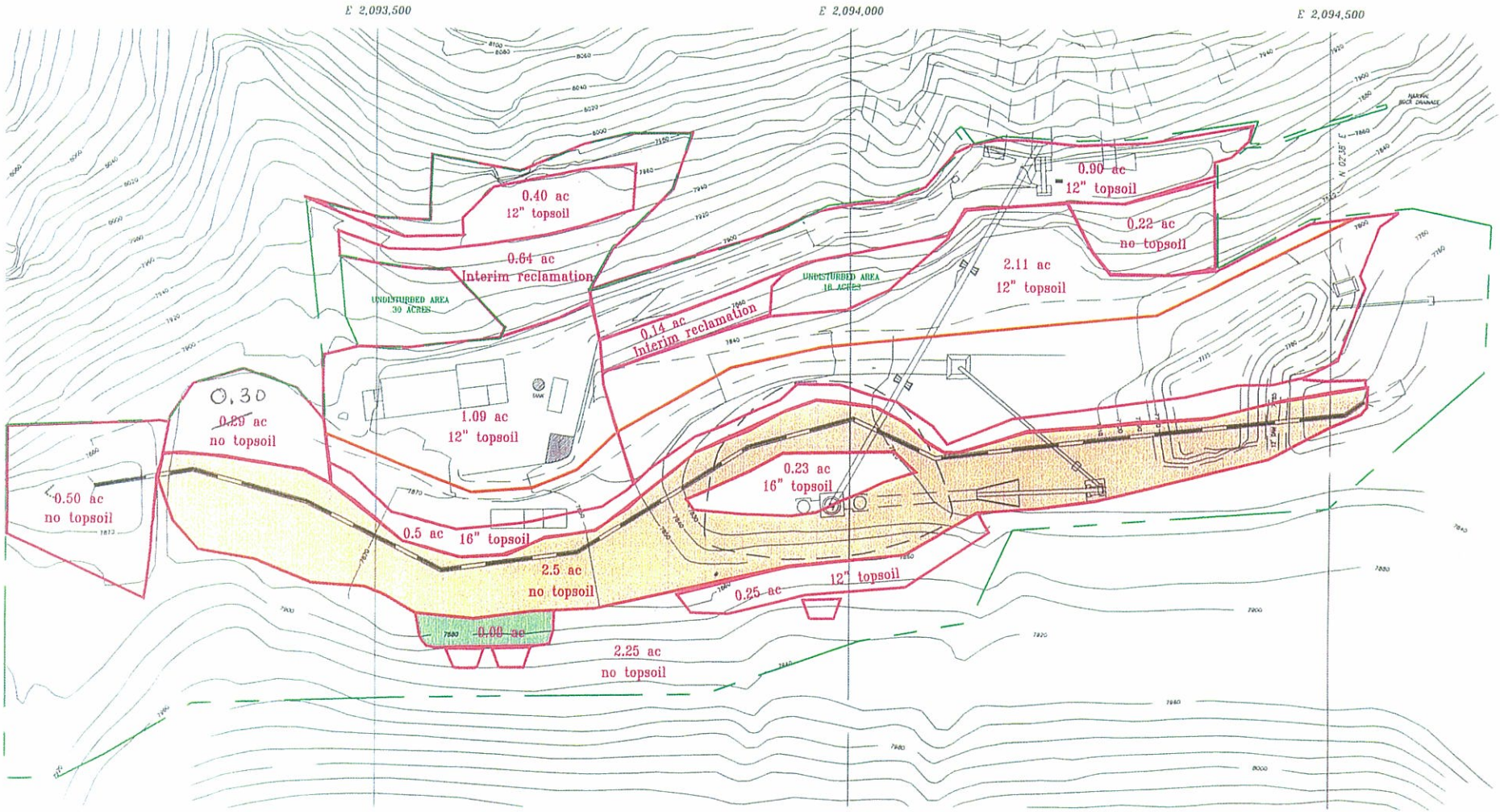
Acad Ref: FIG-8B.dwg



12" Topsoil		16" Topsoil		No Topsoil	
Shop Area	1.09 ac	N. Slope Area	0.50 ac	FS Road	0.53 ac
Old Loadout Area	2.11 ac	S. Slope Bench Area	0.23 ac	Trailhead	0.29 ac
Portal Area	0.90 ac	South Portals	0.11 ac	Topsoil Storage	0.90 ac
Old Substation Area	0.40 ac			Interim Reclamation	0.78 ac
Coal Pile Area	0.25 ac			Undisturbed Areas – N. Side	0.48 ac
				Undisturbed Area Culvert Inlet	0.50 ac
				South Slope Area	2.50 ac
				Undisturbed Expan. Area	2.00 ac
				Area East of Old Loadout	0.22 ac

FIGURE 8C
SOIL REDISTRIBUTION AREAS

Acad Ref: soilare.dwg



INCORPORATED

JUL 28 2005

DIV OF OIL GAS & MINING

INCORPORATED

APR 02 2003

DIV OF OIL GAS & MINING

FIGURE 8D
SOIL AREAS PROTECTED BY GEOTEXTILE

Proposed South Portals

Culvert Expansion

Acad Ref: Fig 8D.Dwg

APPENDIX 2-3B

SUPPLEMENTAL SOIL INVENTORY

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

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.

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,

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.

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.

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.

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

(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.

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

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

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

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	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

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.

TABLE 8-2 (cont.)

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

		UDOGM Acceptable Range	Sample Number	
Parameter	Units		TH-2 0.50-1.10'	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

TABLE 8-3

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

		UDOGM Acceptable Range	Sample Number		
Parameter	**Units**		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

TABLE 8-3 (cont.)

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

		UDOGM Acceptable Range	Sample Number		
Parameter	Units		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

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

ATTACHMENT A

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

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

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

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	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					

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

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	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

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

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	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

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

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	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

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

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE210-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

Th #2
1 Bag

Sample taken at Genwal

Sample taken by Genwal

Date sampled June 26, 1995

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

Date received June 27, 1995

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

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)

Munsell Color 5YR 2.5/1, Black

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-9300 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

B1 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. 59-182269

SOIL ANALYSIS

pH	6.2 units	Rock Fragments	0.0 %
Conductivity	0.35 mmhos/cm	Total Nitrogen	0.09 %
Saturation %	45.6	Organic Carbon	2.4 %
		Carbonate	0.1 %
		Available Phosphorus	2.21 mg/Kg
		Alkalinity	2.22 meq/liter

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

Available Water Capacity

5.0	(1/3)
4.4	(15)

Munsell Color 10YR 6/3, Pale Brown

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-9300 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

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

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)

Munsell Color 10YR 6/3, Pale Brown

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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: Soil / Coal

Cl 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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

APPENDIX 2-5

SURFACE FACILITY EXPANSION - TOPSOIL REMOVAL REPORT

APPENDIX 2-5
SURFACE FACILITY EXPANSION - TOPSOIL REMOVAL REPORT
TABLE OF CONTENTS

PART I — GENWAL MINE - CRANDALL CANYON
Soil Salvage Practices - Surface Expansion
Summer, 1997

PART II — GENWAL MINE - CRANDALL CANYON
Soil Salvage Practices - Surface Expansion
August 1998

MAP: FIGURE 8B Soil Salvage Areas

PART I

GENWAL MINE - CRANDALL CANYON
Soil Salvage Practices - Surface Expansion
Summer, 1997

GENWAL MINE - CRANDALL CANYON

Soil Salvage Practices
Summer, 1997

October, 1997

Submitted to:

Genwal Resources, Inc.
P.O. Box 1420
195 North 100 West
Huntington, Utah

Submitted by:

Patricia K. Johnston
399 "E" Street
Helper, Utah 84526
(801)472-3321

Genwal Resources, Inc., Culvert Expansion

Soil Salvage Project
Summer, 1997

1.0 Introduction

The soil recovery operation at Genwal was supervised and monitored by privately contracted environmental consultant, Patricia K. Johnston, Reclamation Specialist and closely scrutinize by Division of Oil and Gas Mining, Soil Reclamation Specialist, Robert Davidson, July through September, 1997. This was to fulfill the requirements outlined in Chapter 2.0 of the M&RP to maintain, protect and redistribute stockpile topsoil and subsoil of the Genwal disturbed area as described and mapped in Figure 8B of Appendix 2-3B, Supplemental Soil Inventory, revision 6/19/97.

Soil recovery volumes and location of soil resources was determined through extensive soil sampling and mapping conducted in the summer of 1995 and 1996. It was agreed that soil recovery would be maximized in those areas where depth would allow for additional soil salvage, recognizing that soil recovery may not be met in other map units where soil resources may be more limited. An additional soil salvage area was identified by Davidson of DOGM and Gary Gray of Genwal, Inc. The soils recovered from this area would contribute to the established target volume required. This area has been identified as "Soil Salvage Area D." It is located in the southwest corner of the Forest Service Special Use Permit Area for this project.

Additionally, a new topsoil storage pile was established at the mouth of Crandall Canyon and marked Topsoil Pile #4. This topsoil stockpile will conform to DOGM and U.S. Forest Service regulations.

The presence of rock and vegetative material in the top soil stock pile was considered acceptable and desirable. (Personal Communication, Robert Davidson, DOGM Soil Reclamation Specialist.) These components were incorporated in the top soil stock pile as available during the soil stripping and recovery process.

2.0 Methodology

Topsoil and subsoil was removed using the island method. Figure 8B, Soil Salvage Area served as a guide for soil removal volumes and locations.

The reclamation specialist contracted by Genwal examined each truckload of soil for quality and quantity. An accounting of the amount of soil recovered from the various sites within the mine was also documented.

Soil resource volumes were arrived at by keeping a daily record of truck loads that deposited material in top soil stock pile #4. Each vehicle would hold a capacity of 12 cubic yards of soil, all trucks were loaded to capacity.

3.0 Observations and Discussion

Soil Salvage Area	Acreage	Volume Salvaged
Map Unit A (N. Slope Area)	0.11	180 cubic yards
*Map Unit B (S. Slope Bench Area)	0.23	
*Map Unit C (Coal Pile Area)	0.25	1,728 cubic yards
Map Unit D (SW corner Permit Area)	0.50	1,872 cubic yards
TOTAL SOIL SALVAGED (August-September, 1997)		3,780 cubic yards

*Soil Salvage Areas B & C were combined and made contiguous during salvage operation.

Target soil salvage volume projected was 3,480 cubic yards. Actual soil salvage operation exceed target volume with a figure of 3,780 cubic yards.

PART II

GENWAL MINE - CRANDALL CANYON
Soil Salvage Practices - Surface Expansion
August, 1998

GENWAL MINE - CRANDALL CANYON

Soil Salvage Practices - Surface Expansion
August 1998

GENWAL Resources, Inc.
P.O. Box 1420
195 North 100 West
Huntington, Utah 84528

Submitted by:

Patricia K. Johnston
399 "E" Street
Helper, Utah 84526
(435) 472-3321

GENWAL Resources, Inc.
Soil Salvage Project - Surface Expansion
August, 1998

1.0 INTRODUCTION

In order to abate Division of Oil, Gas and Mining violations N98-45-1-1 and N98-45-3-1, top soil salvage was required within Map Unit F, of Figure 8B, Soil Salvage Areas. The operation was supervised and monitored by privately contracted environmental consultant, Patricia K. Johnston, Reclamation Specialist, August 5-18, 1998. This was necessary due to the unexpected height of the coal pile which encroached upon the north facing slope at the southern edge of the Forest Service Special Use Permit Area.

2.0 METHODOLOGY

It was necessary to rake and vacuum the top soil surface before salvage could commence. In order to accommodate anticipated future volumes in the coal pile area, the upper slope was stripped of large woody vegetation prior to top soil salvage.

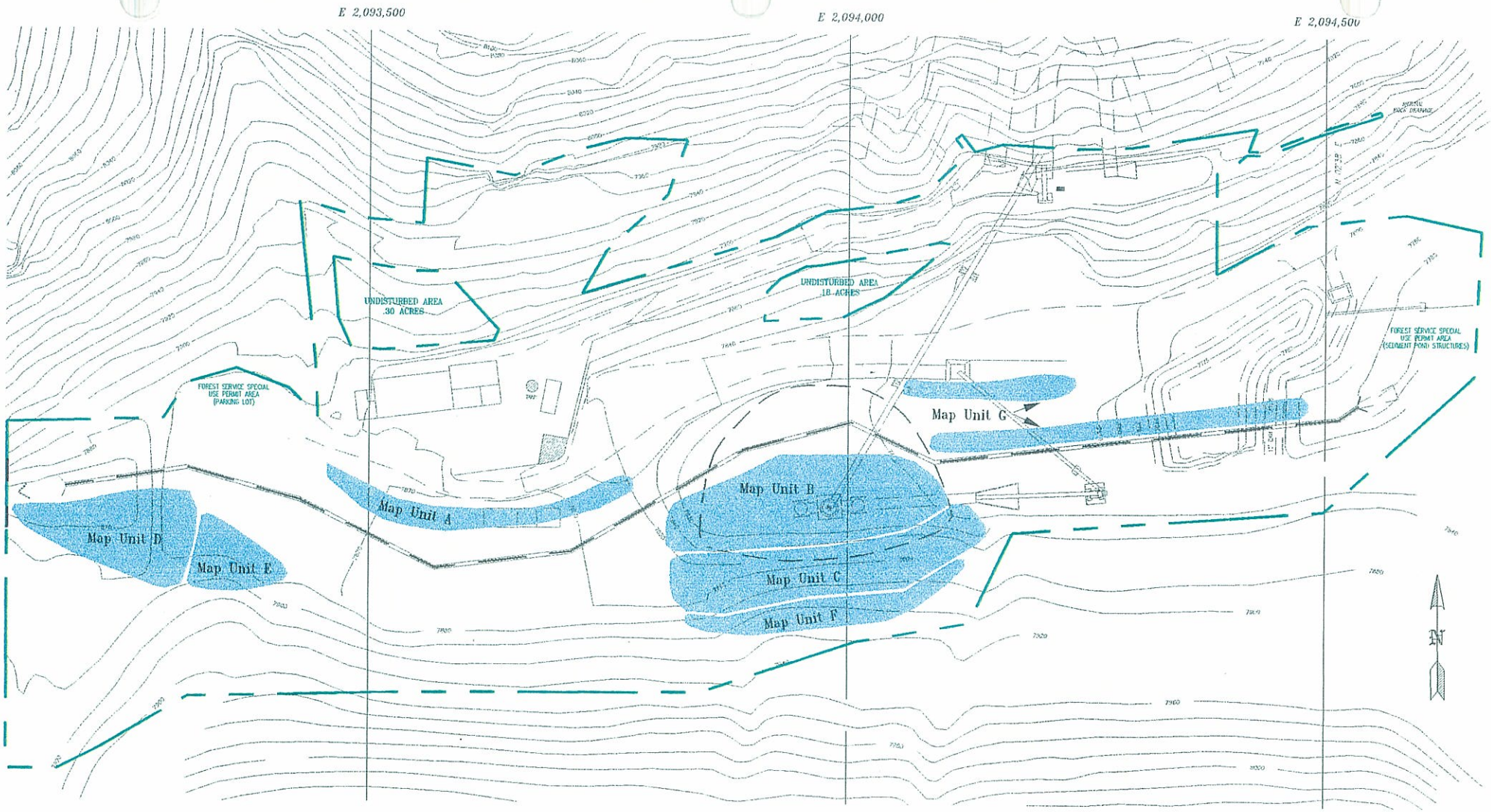
Top soil that had previously been buried under the coal pile was cleaned as thoroughly as possible with existing technology. Small amounts of coal dust and scattered coal "rocks" were an unavoidable part of the top soil salvage. Coal dust and coal did not exceed 10% of the salvaged soils.

Due to the steepness of the upper slope, it was necessary to remove 8-9" of soil. This exceeded the depth of the true top soil resource. True top soil depth was less than 3". In order to stabilize the track hoe and maintain equipment balance on the exceedingly steep slope, a deeper cut of 8-9" was necessary. The equipment operator was conscientious about taking only the top soil resource, but was constrained by equipment limitations.

On the lower slopes, with considerably milder slopes, shallower cuts into the soil surface more closely matched top soil depths of 3-4".

3.0 RESULTS

Approximately 690 cubic yards of top soil was removed from Map Unit F during August 5-18, 1998 and stored in top soil stockpile #4.



SOIL SALVAGE AREAS

	Acreage	Volume
Map Unit A (E. Slope Area)	0.14 ac	180 yd.3
Map Unit B (S. Slope Bench Area)	0.49 ac	1,728 yd.3
Map Unit C (Coal Pile Area)	0.41 ac	
Map Unit D (SW corner of mine yard)	0.28 ac	1,872 yd.3
Map Unit E (Nose cut area)	0.11 ac	108 yd.3
Map Unit F (coal pile area)	0.15 ac	690 yd.3
Map Unit G (loadout/pond area)	0.22 ac	178 yd.3

09/04/98

FIGURE 8B SOIL SALVAGE AREAS

Scale: 1" = 150'

TOP SOIL SALVAGE PHASE 2
AUGUST 1998
VACUUM AND STRIPPING WITH TRACK HOE

RECOVERED TOP SOIL
COAL AND COAL DUST CONSTITUTES
LESS THAN 10% OF VOLUME

RECEIVED
SEP 11 1998
DIVISION OF
OIL, GAS AND MINING

TOP SOIL STRIPPING
3-4" RECOVERED ON LOWER SLOPES

INCORPORATED
EFFECTIVE:
SEP 11 1998
UTAH DIVISION OIL, GAS AND MINING

MAP UNIT F - AFTER TOP SOIL REMOVAL

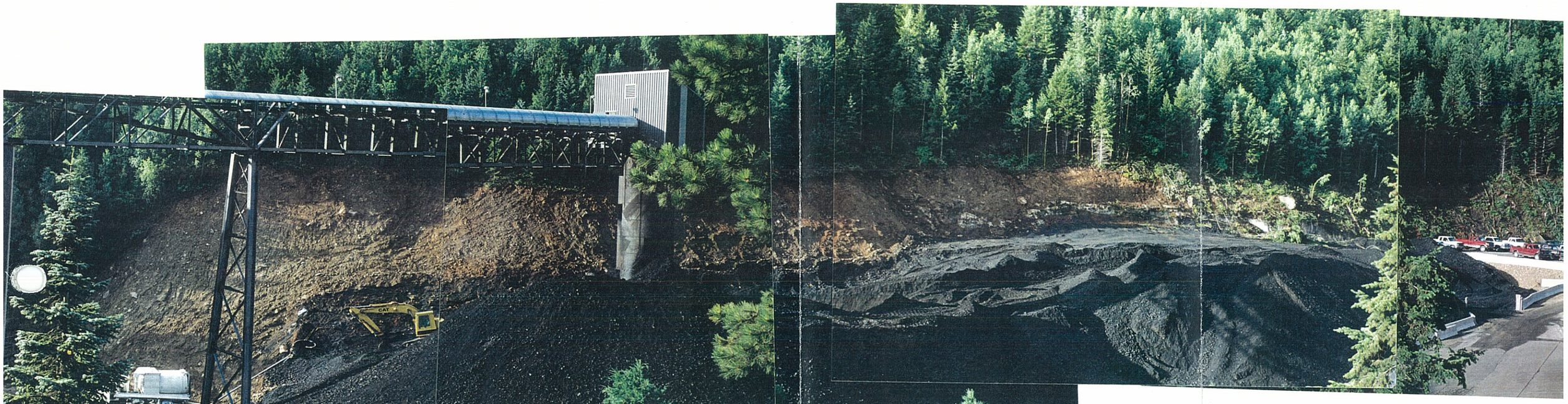
NOTE: APPROXIMATE DEPTH OF TRUE TOPSOIL - LESS THAN 3".

TOP SOIL CLEANING

RAKING & VACUUMING

GENWALL - CRANDALL

SOIL SALVAGE - PHASE 2



Panorama View - Genwall - Crandall Canyon
Soil Salvage Map Unit F 690 yd.^{3}
August 1998 Phase 2 - Soil Salvage

APPENDIX 2-6

SOIL SURVEY REPORT
PROPOSED PHASE TWO EXPANSION AREA
(SOUTH PORTALS)
JAMES NYENHUIS

4/05/2003

APPENDIX 2-6

SOIL SURVEY REPORT
PROPOSED PHASE TWO EXPANSION AREA
(SOUTH PORTALS)
JAMES NYENHUIS

11/22/02

SOIL SURVEY REPORT
PROPOSED PHASE TWO EXPANSION AREA
CRANDALL CANYON MINE

for

GENWALL RESOURCES, INC.
Huntington, Utah

Submitted to:
ANDALEX RESOURCES, INC.
Price, Utah

Submitted by:

James H. Nyenhuis 970 204 9167
Cert. Professional Soil Scientist, ARCPACS 2753
600 Ramah Drive
Fort Collins, CO 80525

March 1999

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 OBJECTIVES	1
2.0	METHODS - SCOPE OF WORK	2
	2.1 EXISTING DATA REVIEW AND EVALUATION	2
	2.2 SOIL MAPPING	2
	2.3 SOIL SAMPLING AND PROFILE DESCRIPTION	3
	2.4 EVALUATION OF SOIL SUITABILITY	3
3.0	RESULTS AND DISCUSSION	5
	3.1 REVIEW OF EXISTING SOILS INFORMATION	5
	3.2 SOIL SURVEY MAP	5
	3.3 SOIL LABORATORY RESULTS	6
	3.4 SOIL MAP UNIT DESCRIPTIONS	6
	3.4.1 South-Facing Slope	7
	3.4.1.1 Map Unit C	7
	3.4.1.2 Map Unit D	7
	3.4.1.3 Map Unit RL-RO	8
	3.4.1.4 Map Unit REC	8
	3.4.2 North-Facing Slope	8
	3.4.2.1 Map Unit E	8
	3.4.3 Crandall Creek Stream Terrace	9
	3.4.3.1 Map Unit F	9
	3.5 SOIL PROFILE DESCRIPTIONS	9
	3.5.1 Pathead gravelly sandy loam	10
	3.5.2 Datino gravelly sandy loam	10
	3.5.3 Lucky Star loam	11
	3.5.4 Becks Family gravelly sandy loam	11
	3.6 SOIL SUITABILITY, RECOMMENDED SALVAGE DEPTHS, AND SOIL VOLUMES	12
	3.6.1 Map Unit C	12
	3.6.2 Map Unit D16	13
	3.6.3 Map Unit RL-RO	13
	3.6.4 Map Unit REC	14
	3.6.5 Map Unit E	14
	3.6.6 Map Unit F	14
4.0	REFERENCES	15

LIST OF TABLES

Table		Page
1	Parameters and Analytical Procedures for Soil Analysis	19
2	Soil Suitability Criteria	20
3	Field Soil Profile Descriptions	21

LIST OF APPENDICES

APPENDIX A - Soil Laboratory Data A-1

1.0 INTRODUCTION

This report is prepared subsequent to a field study performed to characterize the soil resources and determine the potential soil salvage depths of the proposed expansion area at the Genwall Resources, Inc. Crandall Canyon Mine located northwest of Huntington in Emery County, Utah.

1.1 OBJECTIVES

The basic objectives of the field investigation were to map and describe the soils of the study area in sufficient detail to characterize their physical and chemical properties, and depths to which they may be salvaged as a source of topsoil for reclamation purposes. Thus, the site-specific characteristics of the soil that may influence soil salvage, stockpiling, and redistribution were inventoried. A detailed Order 1 soil survey, including mapping, sampling, description, laboratory analysis, suitability evaluation, and report preparation was needed to generate the required information. The general objectives relating to the soil survey are as follows:

- Satisfy soils requirements as found in UDOGM "Guidelines for Management of Topsoil and Overburden for Underground and Surface Mining" (Leatherwood and Duce 1988);
- Collect, review, and evaluate all existing soils, vegetation, geologic, hydrologic, and climatic information to gain a basic understanding of the soils and related disciplines on the site prior to initiation of field work;
- Describe, sample, evaluate, and report site-specific soils data;
- Prepare a soils report, including recommended soil salvage depths, to aid in the completion of the reclamation planning documents needed for permit approval.

2.0 METHODS - SCOPE OF WORK

2.1 EXISTING DATA REVIEW AND EVALUATION

All existing soils and related discipline information for the general study area was compiled and reviewed prior to initiation of the soils field work. This review included soils information for the site taken from: (1) Appendix 2-3B, Supplemental Soils Inventory for the Crandall Canyon Proposed Culvert Expansion (revised 6-19-97), (2) previous USFS mapping in the area and their map unit and taxonomic unit descriptions on file (Manti-LaSal National Forest 1995), and (3) the "Soil Survey of Parts of the Price River and Huntington River Watersheds" (Swenson et. al. 1983). Project maps and air photos were also reviewed.

It should be noted that all methods for soil survey work performed as part of this project are standard methods for detailed Order 1 soil surveys. All procedures and methods were in accordance with current Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) and UDOGM soil survey methods for coal mining projects. Furthermore, all technical specifications were in accordance with current standards and procedures of the USDA-NRCS National Cooperative Soil Survey Program.

2.2 SOIL MAPPING

Mr. James Nyenhuis, a Certified Professional Soil Scientist/Soil Classifier (ARCPACS 2753), mapped soils at the Order 1 level of intensity for the proposed expansion area. The mapping and sampling activities were conducted on August 19 and October 30, 1998. The field mapping was done utilizing the Crandall Canyon Mine Surface Facility (Topographic) Map at a scale of 1"=50'.

All standards and procedures for soil mapping and profile description were in accordance with current NRCS methods, as described in the Soil Survey Manual (Soil Survey Staff 1993); National Soils Handbook, as currently amended (Soil Survey Staff 1997); Keys to Soil Taxonomy, eighth edition (Soil Survey Staff 1998), Field Book for Describing and Sampling Soils (Schoeneberger et.al. 1998), and applicable UDOGM topsoil and overburden guidelines (Leatherwood and Duce 1988).

Upon initiation of soils field work, traverses were walked to determine overall soil and landscape characteristics. Each major soil/landscape unit was tentatively located on the ground and delineated on the base maps. Based on these preliminary observations, representative sample sites were selected for detailed soil pedon description and sampling. Backhoe pits were dug at some of the sample sites; other sites were hand-dug.

2.3 SOIL SAMPLING AND PROFILE DESCRIPTION

Each typical soil pedon was described and sampled according to current methods and standards of the National Cooperative Soil Survey. The following parameters were described, by horizon, for each soil pedon: horizon symbol, depth, and boundary; color; texture; structure; consistence; coarse fragment content; effervescence; clay films if present; soil mottles if present; and the amount, size, and depth of major roots. In addition, general site information was recorded at each sampling site including: existing dominant vegetation, physiography-landform, slope, aspect, erosion condition, drainage class, and depth to a saturated zone or ground water if encountered.

Samples were collected in the field and analyzed at Inter-Mountain Laboratories (IML) in Farmington, New Mexico for standard soil parameters. The soil analyzes included pH; electrical conductivity (EC); saturation percent; calcium, magnesium, and sodium (meq/l); sodium adsorption ratio (SAR), texture including sand, very fine sand, silt, and clay; calcium carbonate percent; Boron (ppm); Selenium (ppm); Total Kjeldahl Nitrogen (TKN) percent; Nitrate Nitrogen (mg/L); Total Organic Carbon (TOC) percent; Organic Matter percent; and 1/3 bar and 15 bar water capacity.

Table 1 is list of "Parameters and Analytical Procedures for Soil Analysis" and is taken from IML's standard methods and procedures. These methods are consistent with those recommended by UDOGM (Leatherwood and Duce 1988).

The sampling site locations and numbers were plotted on the field map as accurately as possible. All sample locations were flagged and numbered in the field. Samples were collected from fresh backhoe pits or hand-dug pits. The sampled soil material was placed in clean, labeled, polyethylene plastic bags, and kept cool and as dry as possible to limit chemical changes. The upper horizons of many profiles were moist upon sampling, and were air dried prior to shipment to IML for analysis. Each sample was split at the laboratory with one portion being used for analysis and an archival portion retained for additional tests, if necessary.

2.4 EVALUATION OF SOIL SUITABILITY

Criteria to establish suitability of soil (topsoil) or soil substitute material were largely those contained in the UDOGM "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining" Table 2 "Overburden Evaluation for Vegetative Root Zone" (Leatherwood and Duce 1988). This information is presented as Table 2, "Soil Suitability Criteria".

One exception to criteria presented in Table 2 was utilized. Although Table 2 considers >30 percent rock fragments (for both gravels, 2mm to 3" in size; and cobbles, 3" to 10" in size) to be

unacceptable; and >10 percent stones and boulders (>10" in size) to also be unacceptable, recent discussion with UDOGM soil scientist Mr. Robert Davidson, and experience on similar projects, supports a rationale for salvaging and reclaiming with soils which have a higher rock fragment content (Davidson 1998). Although higher unacceptable thresholds were not set, the revised practice is to salvage suitable soil with higher amounts of rock content, perhaps as high as 50 to 60 percent for gravels and cobbles, and up to 35 percent for 10" to 24" stones, and up to 20 percent for small boulders.

All field and laboratory data have been analyzed and evaluated using standard soil suitability, interpretation, and classification criteria. Soils were classified according to current Soil Taxonomy criteria as stated in eighth edition of Keys to Soil Taxonomy (Soil Survey Staff 1998), and then correlated to NRCS soil series as possible.

Correlation of site-specific soils to NRCS soil series, if possible, allows use of established NRCS soil interpretation values such as hydrologic group number (for runoff evaluation), "K" factors (for use in water erosion hazard evaluations), and "WEG" group number (wind erodibility group status for wind erosion hazard evaluation) for the site-specific soils. In addition, one may quantitatively determine the "K" factor and "WEG" from use of the field and laboratory data and appropriate nomographs.

3.0 RESULTS AND DISCUSSION

3.1 REVIEW OF EXISTING SOILS INFORMATION

The soils within the Crandall Canyon Mine Disturbed Area Boundary have been previously inventoried. A general mapping of the soils in Crandall Canyon, at a scale of 1"=2000', was completed by the Forest Service as part of their soil survey in progress (Manti-LaSal National Forest 1995). This information is contained in the soil survey file at the Forest Service office in Price, Utah, and is also on file at the Andalex Resources office in Price.

Three map units were delineated by the Forest Service in the area: Map Unit 20 (Strych-Pathead-Podo Families-Rubbleland Complex, 30 to 80% slopes), Map Unit 107 (Curecanti-Elwood-Duchesne Families Complex, 20 to 70% slopes), and Map Unit 711 (Bundo-Lucky Star-Adel Families Complex, 30 to 70% slopes). Descriptions for these units are contained in the Crandall Canyon Mine PAP (Appendix 2-7, Soil Survey Information, Genwall Resources, Inc. - Crandall Canyon Mine, Mill Fork Lease Tract, Crandall/Huntington Canyon Areas).

In addition to the Forest Service soils information, portions of the proposed disturbed area were also mapped, sampled, and described by Mr. Randy Gainer, Mr. Chris Hansen, and Mr. David Steed (Crandall Canyon Mine, Proposed Culvert Expansion, Supplemental Soil Inventory, Appendix 2-3B, Revised 6-19-97). Most of this field work was conducted within the Proposed Culvert Disturbed Area with Map Units A and B delineated along two narrow stream terrace benches. The soils in Map Units A and B were described in the field and soil samples were analyzed by Inter-Mountain Laboratories in Farmington, New Mexico, but were not classified and correlated to soil series names. This work is depicted on the soils map previously presented as Plate 2-4 of the Crandall Canyon Mine PAP.

Only one sample site (TH-2) was located on the north-facing slope located on the south side of Crandall Creek within the Disturbed Area Boundary. No sample sites were located on the south-facing slope located north of Crandall Creek nor on the stream terrace located just west of the permit boundary. These areas (the north and south-facing slopes above Crandall Creek) retained the map unit numbers used in the Forest Service mapping (Map Units 107 and 711 for the north-facing slope, and Map Unit 20 for the south-facing slope). The stream terrace located just west of the permit boundary was included in Map Unit 711.

3.2 SOIL SURVEY MAP

As part of the current survey, a detailed soils map was completed in the field, at a scale of 1"= 50', on a topographic base map of the study area. The soils map is attached to this report. The legend on the map includes all map unit symbols and names, as well as the soil sample locations and site numbers.

Six map units were delineated within the current study area and will be described below. The map units are:

- Map Unit C, Pathead gravelly sandy loam, 40 to 70% slopes
- Map Unit D, Datino gravelly sandy loam, 20 to 35% slopes
- Map Unit RL-RO, Rubbleland-Rock Outcrop
- Map Unit REC, Reclaimed Land
- Map Unit E, Lucky Star loam, 40 to 80% slopes
- Map Unit F, Becks Family, 2 to 6% slopes

3.3 SOIL LABORATORY RESULTS

The soil laboratory data for the 15 sample locations is presented as Appendix A. A total of 28 soil samples were analyzed by Inter-Mountain Laboratories of Farmington, New Mexico. Six of the profiles (CC1 through CC6) fully sampled by major horizon. For all nine sample sites on the north-facing slope (GW-1 through GW-9), a composite sample of the upper two feet was collected for analysis.

The soil samples were analyzed by Inter-Mountain Laboratories (IML) in Farmington, New Mexico, and the results meet quality assurance and quality control (QA/QC) specifications. The results of a standard 10 percent rerun are very similar to the original results, and are included with the laboratory data in Appendix A.

3.4 SOIL MAP UNIT DESCRIPTIONS

The current study was conducted in order to obtain more site-specific data in the three areas mentioned above: (1) the south-facing slope on the north side of Crandall Creek, (2) the north-facing slope on the south side of Crandall Creek, and (3) the stream terrace just south of Crandall Creek located immediately west of the Disturbed Area Boundary at the Crandall Canyon Mine. The six map units are grouped according to the slope or terrace on which they appear. Map Units C, D, RO-RL, and REC are located on the south-facing slope. Map Unit E is located on the north-facing slope, and Map Unit F is located on the stream terrace of Crandall Creek just west of the Disturbed Area Boundary.

3.4.1 South-Facing Slope

The first area is the south-facing slope located upslope from the existing mine shop and the Forest Service trailhead parking area. Both the mine shop and the trailhead parking area are located on the extended upper pad at the mine. Elevations range from approximately 7870 to 7925 feet and are similar to those for the north-facing slope. Native vegetation is a mixture of Utah juniper, aspen, sagebrush, Douglas fir, wild rose, and grasses. Four hand-dug pits were described and sampled on this slope (CC-1, CC-2, CC-3, and CC-4). The "CC" prefix is for "Crandall Canyon".

3.4.1.1 Map Unit C, Pathead gravelly sandy loam, 40 to 70% slopes

Map Unit C is the largest and most dominant map unit on this south-facing slope. Three sample sites (CC-2, CC-3, and CC-4) are located in Map Unit C, and the soil correlates to the Pathead soil series. Pathead is well drained and is forming in residuum and colluvium from sandstone and shale. It classifies as a "Loamy-skeletal, mixed (calcareous) frigid Typic Ustorthent". Although usually a soil series is included in only one depth category, Pathead can range from moderately deep to deep (Manti-LaSal National Forest 1995).

Pathead has moderate permeability and available water capacity, and rapid runoff. Hydrologic group status is B or C. Rock fragments on the surface and in the surface layer average about 15 percent gravels, 13 percent cobbles, and 6 percent stones and boulders. The major rooting depth was observed to range from 20 to 29 inches. Soil erodibility is moderate, and the erosion hazard of exposed soil is moderate to high. Map Unit C is limited primarily by steep slopes and a moderate to high percentage of rock fragments throughout the Pathead soil profile.

3.4.1.2 Map Unit D, Datino gravelly sandy loam, 20 to 35% slopes

Map Unit D is located on a small fan-toeslope just above the trailhead parking area. Sample site CC-1 is located in Map Unit D, and the soil correlates to the Datino soil series. Datino is well drained and is forming in slopewash alluvium and colluvium from sandstone and shale. It was previously classified as a "Loamy-skeletal, mixed Typic Haploboroll" (Jensen and Borchert 1988), but due to recent changes in soil taxonomy, it now classifies as a "Loamy-skeletal, mixed Typic Haplustoll" (Soil Survey Staff 1998).

Datino is moderately permeable and has moderate to high available water capacity. The major rooting depth was observed to be 26 inches. The organic matter content of the surface layer was 3.6 percent. Hydrologic group status is B, runoff is rapid and the hazard of water erosion is high.

3.4.1.3 Map Unit RL-RO, Rubbleland-Rock Outcrop

Map Unit RL-RO occupies a small area on the west side of a drainage channel that exists upslope between the trailhead parking area and the mine shop. Rubbleland has many scattered surface stones and boulders. Rock outcrop is exposed sandstone. Small inclusions of the Pathead soil are intermingled throughout the unit. Pathead inclusions constitute about 15 percent of the unit.

3.4.1.4 Map Unit REC, Reclaimed Land

Map Unit REC (Reclaimed Land) is located on a narrow linear area in which a culvert was placed on the slope adjacent to the above-mentioned drainage. Soil was reapplied above the culvert and revegetation is present. No soil samples were taken of this reapplied topsoil. It is estimated that approximately six inches of soil was reapplied to this small area.

3.4.2 North-Facing Slope

The second part of the current study area is a very steep north-facing slope located on the south side of Crandall Canyon just above the lower and extended upper pads at the mine. Elevation ranges from approximately 7870 to 7960 feet. Native vegetation primarily is a mixture of Douglas fir and White fir communities.

Six backhoe pits (GW-1 through GW-6) were dug across the slope in an area where the slope had been cleared. The trees had been previously cut off at about one-foot height above the ground surface although the surface itself had not been disturbed. Three additional sample sites (GW-7, GW-8, and GW-9) were located and hand-dug in an adjacent forested area on the slope above the coal storage pile. As mentioned above, one previous soil sample site (TH-2) was also located on this north-facing slope.

3.4.2.1 Map Unit E, Lucky Star loam, 40 to 80% slopes

Map Unit E was designated for soils on this north-facing slope. Most of this slope was previously designated as Map Unit 711. The small portion of the slope previously mapped as Map Unit 107 was not part of the current survey and remains as Map Unit 107. Lucky Star was previously classified as a "Loamy-skeletal, mixed Boralfic Cryoboroll" (Manti-LaSal National Forest 1995), but due to recent changes in soil taxonomy it now classifies as a "Loamy-skeletal, mixed Ustic Haplocryoll" (Soil Survey Staff 1998).

Although Lucky Star is a deep soil, it ranges from moderately deep (20 to 40 inches to bedrock) to deep (40 to 60 inches to bedrock) on the study area. Permeability and available water capacity are both moderate, runoff is slow to medium, and hydrologic group status is B. Rock

fragment content of the surface layer averages about 13 percent and is equally divided among gravels, cobbles, and stones and boulders. The major rooting depth was observed to be 24 inches. Soil erodibility is low, and the erosion hazard of exposed soil is moderate to high. Map Unit E is limited by steep slopes.

3.4.3 Crandall Creek Stream Terrace

The third part of the current study area is a stream terrace located on the south side of Crandall Creek and just west of the mine permit area boundary. Elevation ranges from approximately 7890 to 7910 feet. Native vegetation includes Douglas fir, aspen, and mixed grasses. A portion of this bench appears to have been slightly disturbed at some time in the past, perhaps for a turn-around at the end of an old two-track road or to pile timber or slash, and it has been naturally somewhat revegetated with sparse young aspen.

Although the dominant soil on this terrace appears to be similar to those previously described and sampled as Map Units A and B, a separate unit (Map Unit F) was designated for soils on this particular stream terrace located just outside the mine permit area boundary. Two sample sites (CC-5 and CC-6) were located on this terrace.

3.4.3.1 Map Unit F, Becks Family, 2 to 6% slopes

Map Unit F is composed of one dominant soil, Becks Family, 2 to 6 percent slopes. Becks Family was previously classified as a "Loamy-skeletal, mixed Aquic Cryoboroll" (Manti-LaSal National Forest 1995), but due to recent changes in soil taxonomy it now classifies as a "Loamy-skeletal, mixed Fluvaquentic Haplocryoll" (Soil Survey Staff 1998).

In the study area, Becks Family is a deep, somewhat poorly drained soil with moderately rapid permeability, slow runoff, high available water supply but moderately low available water capacity, and hydrologic group status D. Rock fragment content of the surface layer is about 15 percent and is mainly gravels. The major rooting depth was observed to be between 17 and 26 inches. Soil erodibility and erosion hazard of the exposed soil is moderate.

3.5 SOIL PROFILE DESCRIPTIONS

Fifteen soil profiles (numbered GW-1 through GW-9 for soils on the north-facing slope, and CC-1 through CC-6 for soils on the south-facing slope and on the Crandall Creek stream terrace) were described and sampled at representative locations within Map Units C, D, E, and F in the study area. The soil profile descriptions are presented in field-notation tabular format in Table 3 of this report. A brief description of the profiles of the four major soils contained in the study area map units follows. The four soils are: Pathead gravelly sandy loam (Map Unit C), Datino gravelly

sandy loam (Map Unit D), Lucky Star loam (Map Unit E), and Becks Family gravelly sandy loam (Map Unit F).

3.5.1 Pathead gravelly sandy loam (Map Unit C)

As stated above, Pathead is classified as a "Loamy-skeletal, mixed (calcareous) frigid Typic Ustorthent". Typically, the "A" horizon surface layer is a brown (10YR 5/3, dry) gravelly sandy loam about 8 inches thick. For purposes of this project, the surface layer includes the true "A" horizon and a similar, immediately underlying, thin transition horizon to the soil substratum. Both of these horizons are grouped together as the "A" horizon. The surface layer has moderate, medium granular structure and neutral to mildly alkaline reaction (pH 7.3 to 7.7). Gravel content is about 15 to 20 percent. Cobbles, stones, and boulders account for an additional 15 to 27 percent.

The underlying "C" horizon substratum is divided into an upper ("C1") and lower ("C2") part. The "C1" upper substratum horizon begins at about 8 inches and ranges in depth from 15 to 29 inches with an average lower depth of 23 inches. Typically, the "C1" horizon is a brown (10YR 5/3, dry) very gravelly sandy loam to sandy clay loam with moderate, medium subangular blocky structure. It has mildly alkaline reaction (pH 7.4 to 7.8). Rock fragment content averages about 32 to 40 percent with about 20 percent gravel, 10 percent cobbles, and 2 to 10 percent stones and boulders.

The "C2" lower substratum horizon begins at the base of the "C1" horizon and generally extends to a depth of 40 inches or more. Typically, the "C2" horizon is a light brownish gray (10YR 6/2, dry) to brown (10YR 5/3. dry) very gravelly sandy clay loam to sandy loam with massive structure. It has mildly to moderately alkaline reaction (pH 7.8 to 8.2). Rock fragment content averages about 55 to 70 percent with 20 to 45 percent gravels, 15 percent cobbles, and 10 to 25 percent stones and boulders.

3.5.2 Datino gravelly sandy loam (Map Unit D)

The Datino soil is classified as a "Loamy-skeletal, mixed Typic Haplustoll". Typically, the surface layer is about 10 inches thick and is composed of an upper ("A1") and lower part ("A2"). It is a very dark grayish brown (10YR 3/2, dry), very dark brown (10YR 2/2, moist) gravelly sandy loam with moderate, medium granular structure and mildly alkaline reaction (pH 7.6 to 7.8). The surface layer meets criteria for a mollic epipedon. Gravel content averages about 15 percent. Cobbles average about 3 to 5 percent, and stones and boulders on the soil surface average about 10 percent.

A cambic "Bw" subsoil horizon underlies the surface layer. For sample site CC1 it extends from 10 to 26 inches in depth and is a yellowish brown (10YR 5/4, dry) sandy clay loam with moderate

medium subangular blocky structure and moderately alkaline reaction (pH 8.2). Total rock fragment content averages about 45 percent with 30 percent gravel, 10 percent cobbles, and 5 percent stones and boulders.

A substratum "C" horizon underlies the subsoil and extends to a depth of 40 inches or greater. It is a brown (10YR 5/3, dry) sandy clay loam with massive structure and moderately alkaline reaction (pH 8.3). Total rock fragment content averages about 45 percent with 30 percent gravels, 10 percent cobbles, and 5 percent stones and boulders.

3.5.3 Lucky Star loam (Map Unit E)

The Lucky Star soil is now classified as a "Loamy-skeletal, mixed Ustic Haplocryoll". Typically, the "A" horizon surface layer is a dark brown (10YR 4/3, dry) loam about 7 inches thick with moderate, medium granular structure and neutral reaction (pH 7.2). Rock fragment content averages about 12 percent with 5 percent gravels, 2 percent cobbles, and 5 percent stones and boulders. The surface layer meets criteria for a mollic epipedon. Along the north-facing slope, the surface layer is overlain by about 1.5 to 2 inches of semi-decomposed needles and twigs comprising an "Oe" horizon.

A cambic "Bw" subsoil horizon often underlies the surface layer and is a yellowish brown (10YR 5/4, dry) loam with moderate, medium subangular blocky structure and neutral reaction. It extends from the base of the surface layer to a depth ranging between 18 and 26 inches. It has a similar rock fragment content as the surface layer. Remnants of a thin eluvial "E" horizon are often found mixed in with the upper part of the "Bw" horizon.

A "C" horizon substratum layer underlies the subsoil and extends to a depth ranging between 30 and 60 inches or more. Along the north-facing slope, weathered coal is often encountered at the base of the soil substratum. The "C" horizon is old colluvial material that has slide downslope and covered the coal layer. The "C" horizon is a light brownish gray (10YR 6/2, dry) very stony sandy loam to sandy clay loam with massive structure. Rock fragment content averages 50 to 75 percent with about 15 percent gravels, 10 percent cobbles, and 35 to 50 percent stones and boulders.

3.5.4 Becks Family gravelly sandy loam (Map Unit F)

The Becks Family soil is now classified as a "Loamy-skeletal, mixed Fluvaquentic Haplocryoll". Typically, the surface layer is a dark grayish brown (10YR 4/2, dry) gravelly sandy loam about 7 to 10 inches thick. It has moderate medium granular structure and neutral to mildly alkaline reaction (pH 6.9 to 7.4). Rock fragment content of the surface layer is only about 15 percent and is 10 percent gravels, 2 to 3 percent cobbles, and 1 to 2 percent stones and boulders. The surface layer meets criteria of a mollic epipedon.

A "BC" subsoil horizon or an upper "C" horizon substratum layer underlies the surface layer. Typically, it is a grayish brown (10YR 5/2, dry) to light yellowish brown (10YR 6/4, dry) very gravelly sand to gravelly sandy loam that extends from the base of the surface layer to a depth of 17 to 26 inches. It has single grain to massive structure and neutral to mildly alkaline reaction (pH 7.2 to 7.8). Rock fragment content varies across the terrace and can range from 18 to 67 percent based on data from the CC5 and CC6 sample sites. Gravel can range from 15 to 55 percent; cobbles from 2 to 10 percent; and stones and boulders from 1 to 2 percent.

The underlying "C" horizon, or lower "C" horizon, substratum extends from the base of the overlying horizon to a depth of 40 inches or more. Typically, it is a very gravelly light brownish gray (10YR 6/2, dry) to dark gray (10YR 4/1, dry) sandy loam with massive structure and mildly alkaline reaction (pH 7.5 to 7.8). The dark gray color of at sample site CC5 is a "low chroma" redoximorphic feature which is consistent with a fluctuating water table beneath this stream terrace. Alluvial groundwater was estimated at the time of sampling to be at about 26 and 30 inches, respectively, for sample sites CC5 and CC6. Rock fragment content ranges from 45 to 55 percent with 30 to 40 percent gravels, 10 percent cobbles, and 5 percent stones and boulders.

3.6 SOIL SUITABILITY, RECOMMENDED SALVAGE DEPTHS, AND SOIL VOLUMES

A reclamation potential suitability evaluation for each soil profile in all study area Map Units was performed based on comparison of site-specific field and laboratory data with criteria and threshold values contained in the UDOGM table "Overburden Evaluation for Vegetative Root Zone" (Leatherwood and Duce 1988). As previously noted, the UDOGM table is included as Table 2 in this report. The results of the suitability evaluation indicate the following.

3.6.1 Map Unit C, Pathead gravelly sandy loam, 40 to 70% slopes

The entire Pathead profile is both non-saline (EC< 1.9) and non-sodic (SAR< 1.1). Calcium carbonate content averages about 25 percent and ranges from 16 to 33 percent. Clay content averages 17 percent and ranges from 11 to 21 percent. Rock fragment content ranges from about 30 to nearly 50 percent for the surface layer, from about 32 to 40 percent for the upper "C" horizon substratum layer, and from about 55 to 70 percent for the lower "C" horizon substratum layer. Organic matter percent averages about 2.6 percent for the surface layer, just under 2 percent for the upper substratum "C1" layer, and about 1.1 percent for the lower substratum "C2" layer. Both Boron and Selenium contents are very low, less than 0.5 mg/Kg (ppm) and 0.02 mg/Kg (ppm) respectively.

In terms of soil suitability, the surface and upper substratum layers, to an average depth of 23 inches, is entirely "good" or "fair" rated assuming that its' 30 to 50 percent rock fragments,

3.6.4 Map Unit REC, Reclaimed Land

If Map Unit REC were to be re-disturbed, it is estimated that approximately 6 inches of suitable soil material may be available for salvage from above the drainage culvert. Soil volume can be calculated subsequent to finalization of expansion plans.

3.6.5 Map Unit E, Lucky Star loam, 40 to 80% slopes

The Lucky Star profile is both non-saline and non-sodic. Organic matter content of the upper 2 feet averages 4.1 percent and ranges from 3.1 to 4.9 percent. Calcium carbonate content of the upper 2 feet averages 12.6 percent and ranges from 6 to 18 percent. Clay content of the upper 2 feet averages 21.8 percent and ranges from 18 to 30 percent. Rock fragment content averages about 12 percent for the upper 2 feet, and about 50 to 75 percent from 2 feet until bedrock is encountered with 35 to 50 percent of these lower rock fragments being stones and boulders. Both Boron and Selenium content are very low with less than 0.5 mg/Kg (ppm) and 0.02 mg/Kg (ppm) respectively.

In terms of soil suitability, the approximate upper 2 feet is entirely suitable for salvage assuming equipment can operate on this very steep slope. Rock fragment content, particularly stones and boulders, are limiting below 2 feet, and water erosion and landslide hazard would increase with deeper salvage. As a result, up to 2 feet of suitable soil is available for salvage from Map Unit E. Soil volumes could be calculated subsequent to finalization of expansion plans.

3.6.6 Map Unit F, Becks Family gravelly sandy loam, 2 to 6% slopes

The entire Becks Family profile is both non-saline (EC< 1.7) and non-sodic (SAR< 0.9). Calcium carbonate content averages about 13 percent, and ranges from 11 to 16 percent. Clay content averages about 13 percent, and ranges from 5 to 17 percent. Rock fragment content of the surface layer averages about 15 percent, and is mainly gravels. It increases with depth from 18 to nearly 70 percent, again mainly gravels. Organic matter content of the surface layer ranges from 2.4 to 3.2 percent. It varies irregularly with depth and ranges from 0.3 to 3.8 percent beneath the surface layer. Both Boron and Selenium contents are very low, less than 0.4 mg/Kg (ppm) and 0.02 mg/Kg (ppm) respectively.

In terms of soil suitability, the surface layer, on average about 8.5 inches thick, is entirely suitable for salvage. The underlying "BC" or upper "C" horizon, to a depth of 17 to 26 inches, can have very gravelly sand texture which is rated unnacceptable, and in addition, has poor rated available water capacity. A fluctuating water table is encountered at the base of this "BC" or upper "C" horizon, on average at about 21 inches. As a result, only the upper 8.5 inches of soil is available for salvage should this stream terrace be proposed for disturbance. Soil volumes could be calculated subsequent to finalization of expansion plans.

4.0 REFERENCES

Davidson, Robert A. 1998. UDOGM Soil Scientist. Personal communication with J. Nyenhuis.

Jensen, Earl H. and James W. Borchert. 1988. Soil Survey of Carbon Area, Ytah. USDA-SCS, in cooperation with USDI-BLM and Utah Agricultural Experiment Station.

Leatherwood James and Dan Luce. April 1988. Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining. State of Utah Department of Natural Resources Division of Oil, Gas, and Mining. Salt Lake City, Utah.

Manti-LaSal National Forest. 1995. Soil Survey of the Manti-LaSal National Forest, Manti Division, Utah; parts of Carbon, Emery, Sanpete, Sevier, and Utah Counties. In Progress.

Schoeneberger, P.J., Wysocki, D.A., Benham, E.C., and Broderson, W.D. 1998. Field Book for Describing and Sampling Soils. Version 1.1. U.S.D.A.-Natural Resources Conservation Service-National Soil Survey Center. Lincoln, Nebraska.

Soil Survey Staff. 1993. Soil Survey Manual. Agricultural Handbook No. 18. U.S. Government Printing Office, Washington, D.C.

Soil Survey Staff. 1997, as amended. National Soils Handbook. Publication 430-VI-NSH. U.S. Government Printing Office, Washington, D.C.

Soil Survey Staff. 1998. Keys to Soil Taxonomy, 8th edition. U.S.D.A.-Natural Resources Conservation Service.

Swenson et.al. 1983. Soil Survey of Parts of the Price River and Huntington River Watersheds.

TABLE 1

Parameters and Analytical Procedures for Soil Analysis

Taken from UDOGM "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining (Leatherwood and Duce 1988), and Inter-Mountain Laboratories, Inc., Standard Methods and Procedures

Parameter-Units	Procedure-Reference
Sample Preparation	Samples were air dried at less than 35°C. Clods were broken up prior to grinding and sieving the sample. Large rock fragments were removed and weighed. Sample material was sieved. Remaining rock fragments left on the 10 mesh (2 mm) sieve were removed and weighed. Remaining soil clods left on the 10 mesh screen were ground until the sample just passed the screen. Excessive grinding of sample material was avoided during the entire sample preparation procedure.
Subsampling less than 2 mm fraction	U.S. Salinity Lab (1969), Method 1.
Rock fragment content percent by volume	SCS Soil Survey Investigation Report No. 1, Method 3B, page 18.
Preparation of saturation extract and saturation percentage determination	ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 10-2.3.1, page 169.
pH (determination using saturated paste)	ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 10-3.2, page 171. pH performed on saturation paste, method 10-2.3.1, page 169.
Conductivity of saturation extract in mmhos/cm at 25°C	ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 10-3.3, pages 172-173. Use saturation paste extract.
soluble calcium, magnesium, and sodium in meq/l	ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 10-3.4. pages 173-174.
Sodium Adsorption Ratio	U.S. Salinity Lab (1969), p. 26.
Selenium (ppm)	Extraction: ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 25-9.1. Analysis: Hydride AA, ASTM D3859-93. 1993.
Boron (ppm)	Extraction: ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 25-9.1. Analysis: by ICP, EPA Method 200.7.
Organic Matter in percent	For OM <7.0%: CSU Tech Bulletin LT B88-2 (1988); For OM > 7.0%: Storer (1984)
Carbonate in percent	ASA Mono. No. 9, Part 2, (2 ed). 1982. Method 11-2.4, pages 188-191.
Particle size analysis in percent sand, silt, and clay	Hydrometer method. Black et al. 1965. Methods of soil analysis. ASA Mono No. 9, Part 1, method 43-5, pages 562-566.
Textural classification	USDA (1951), p. 209.
Sand Fractionation (very fine sand)	ASA Mono. No. 9, Part 1, (2 ed). 1986. Method 15-5.2.4, Pages 405 and 406.

TABLE 2

SOIL SUITABILITY CRITERIA

Parameters	Good	Fair	Poor	Unacceptable
pH	6.1 - 8.2	5.1 - 6.1 8.2 - 8.4	4.5 - 5.0 8.5 - 9.0	<4.5 >9.0
EC mmhos/cm 25°C	0 - 2	2 - 8	8 - 15	>15
Saturation %	25% - 80%		<25% >80%	
Texture	sl, l, sil, scl, vfsl, fsl	c, sicl, sc, ls, lfs	sic, s, sc, c, cos, fs, vfs	g, vcos
SAR	0 - 4	5 - 10	10 - 12 fine texture 10 - 15 coarse texture	>12 fine texture >15 coarse texture
Selenium	less than 0.1 mg/kg			>0.1 mg/kg
Boron	less than 5.0 mg/kg			>5.0 mg/kg
Acid/Base Potential	> -5 tons $CaCO^3$ per 1,000 tons material			< -5 tons $CaCO^3$ per 1,000 tons material
% Coal fines	undetermined at this time			
Available water capacity (in/in)	>0.10	0.05 - 0.10	<0.05	
Rock Fragments (% volume) <3 inches diameter 3 - 10 inches >10 inches	 0 - 15 0 - 15 0 - 3	 15 - 25 15 - 25 3 - 7	 25 - 30 25 - 30 7 - 10	 >30 >30 >10

UDOGM: Overburden Evaluation for Vegetative Root Zone; Table 2 (Leatherwood and Duce 1988).

TABLE 3

SOIL PROFILE DESCRIPTIONS

Horizon[2]	Depth Inches[2]	Texture[3]	Color[4] Dry	Color[4] Moist	Structure[5]	Consistence[6] Dry	Consistence[6] Moist	Consistence[6] Wet	Roots[7]	Rock Fragments[8] %	Reaction[9]	Boundary[10]	Additional Features and Comments
CC4 Pathead, Map Unit C													
A	0-8	Sandy Loam	10YR 5/3	10YR 4/3	M M GR	SO	VFR	SS/SP	Many M, F, VF and Com CO	20 GR, 25 CB, 2 S/B	ES	CS	
C1	8-25	Sandy Loam	10YR 5/2	10YR 4/2	M M SBK	SH	VFR	SS/SP	Many M, F, VF and Com CO	20 GR, 10 CB, 2 S/B	ES	GW	
C2	25-43+	Sandy Loam	10YR 5/3	10YR 4/3	Massive	H	FR	S/SP	Few CO, M, F, VF	45 GR, 15 CB, 10 S/B	ES	--	
	stopped by rocks												
CC5 Becks Family, Map Unit F													
A	0-10	SL	10YR 4/2	10YR 3/2	M M GR	SO	VFR	SS/SP	Many M, F, VF Few CO	10 GR, 3 CB, 2 S/B	EM	CW	
C1	10-26	LS, Sand	10YR 6/4	10YR 5/4	Massive	LO	LO	NS/NP	Many M, F, VF Few CO	55 sub-rounded gravel, 10 CB, 2 S/B	ES	CW	
C2g	26-44	SL	10YR 4/1	10YR 3/1	Massive	H	FI	S/SP		30 GR, 10 CB, 5 S/B	ES	--	
	stopped by rocks												

TABLE 3

SOIL PROFILE DESCRIPTIONS FOOTNOTES

[1] Soil Series, and Soil Classification according to current NRCS information and criteria. Soil classification based on Keys to Soil Taxonomy, eighth edition (Soil Survey Staff 1998).

[2] Horizon and Depth based on site-specific conditions at the sample location.

[3] Texture and texture modifier abbreviations:

S	Sand	SCL	Sandy Clay Loam	CB	Cobbly	GR	Gravely
LS	Loamy Sand	CL	Clay Loam	CBV	Very Cobbly	GRV	Very Gravely
SL	Sandy Loam	SICL	Silty Clay Loam	CBX	Extremely Cobbly	GRX	Extremely Gravely
L	Loam	SIC	Silty Clay	CN	Channery	SH	Shaley
SIL	Silt Loam	C	Clay	CNV	Very Channery	SR	Stratified
SI	Silt			CNX	Extremely Channery		

[4] Color, Dry and Moist: Munsell Soil Color Chart, 1975 Edition.

[5] Structure:

Grade	Size	Type
W Weak	VF Very Fine	PL Platy
M Moderate	F Fine	GR Granular
S Strong	M Medium	SBK Subangular Blocky
	CO Coarse	ABK Angular Blocky
	VCO Very Coarse	PR Prismatic
		W Massive Weak Massive
		Massive
		S Massive Strong Massive
		SG Single Grained
		Cloddy

[6] Consistency:

Dry	Moist	Wet
LO Loose	LO Loose	NS Non Sticky
SO Soft	VFR Very Friable	SS Slightly Sticky
SH Slightly Hard	FR Friable	S Sticky
H Hard	FI Firm	VS Very Sticky
VH Very Hard	VFI Very Firm	NP Non Plastic
EH Extremely Hard	EFI Extremely Firm	SP Slightly Plastic
		P Plastic
		VP Very Plastic

[7] Roots:

Number	Type
Very Few	VF Very Fine
Few	F Fine
Com (Common)	M Medium
Many	CO Coarse

Roots are described in terms of a specified size (type) and quantity (number). The size classes are:

Very Fine: Less than 1 mm in diameter
Fine: 1 to 2 mm in diameter
Medium: 2 to 5 mm in diameter
Coarse: 5 mm or larger in diameter
Roots larger than 10 mm in diameter may be described separately.

Quantity classes or roots are defined in terms of numbers of each size per unit area--1 square centimeter for very fine and fine roots, and 1 square decimeter for medium and coarse roots. All roots smaller than 10 mm in diameter are described in terms of the following quantity classes:

Few: Less than 1 per unit area of the specified size
Common: 1 to 5 per unit area of the specified size
Many: More than 5 per unit area of the specified size
Roots are described as to number first, and type second.

[8] Rock Fragments: All coarse fragment percentages (% by volume) are taken from the field soil profile descriptions. Lithologic modifier types (gravelly, channery, etc.) are also taken from the field soil profile description forms for each sampled profile.

[9] Reaction:

Effervescence	
EO	Non-Effervescent
SE	Slightly Effervescent
EM	Moderately Effervescent
ES	Strongly Effervescent
EV	Violently Effervescent

Reaction		pH
Str. Acid	Strongly Acid	5.1 - 5.5
Mod. Acid	Moderately Acid	5.6 - 6.0
Sl. Acid	Slightly Acid	6.1 - 6.5
Neutral	Neutral	6.6 - 7.3
Mild. Alk.	Mildly Alkaline	7.4 - 7.8
Mod. Alk.	Moderately Alkaline	7.9 - 8.4
Strong Alk.	Strongly Alkaline	8.5 - 9.0
Very Strong Alk.	Very Strongly Alkaline	>9.0

[10] Horizon Boundaries:

Distinctness
- A Abrupt (<2 cm thick)
- C Clear (2 to 5 cm thick)
- G Gradual (5 to 15 cm thick)
- D Diffuse (>15 cm thick)

Topography
- S Smooth (the boundary is a plane with few or no irregularities)
- W Wavy (the boundary has undulations in which depressions are wider than they are deep)
- I Irregular (the boundary has pockets that are deeper than they are wide)
- B Broken (at least one of the horizons or layers separated by the boundary is discontinuous and the boundary is interrupted).

APPENDIX A

SOIL LABORATORY DATA

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

Andalex Resources, Inc.

Price, UT

Client Project ID: Genwal/Himonas

Date Received: 08/26/98

IML Project #0398S04914

Report Date: 09/18/98

Lab Id	Sample Id	Depths	pH	EC	Saturation	Ca	Mg	Na	SAR	Sand	Silt	Clay	Texture USDA	CaCO3
		Feet	s.u.	mmhos/cm	%	meq/L	meq/L	meq/L		%	%	%		%
0398S04914	GW-1	0 - 2	7.2	0.582	45	4.4	1.3	0.43	0.26	46	35	19	L	6.0
0398S04915	GW-2	0 - 2	7.1	0.464	44	3.5	1.2	0.53	0.34	36	38	26	L	16
0398S04916	GW-3	0 - 2	7.2	0.507	50	3.5	1.6	0.46	0.29	34	36	30	CL	12
0398S04917	GW-4	0 - 2	7.0	0.561	42	4.1	1.5	0.40	0.24	44	35	21	L	17
0398S04918	GW-5	0 - 2	7.3	0.550	53	4.5	1.1	0.33	0.20	42	38	20	L	18
0398S04919	GW-6	0 - 2	7.1	0.550	52	4.3	1.5	0.37	0.22	38	37	25	L	11
0398S04920	GW-7	0 - 2	7.3	0.485	41	4.0	1.1	0.37	0.24	50	32	18	L	9.2
0398S04921	GW-8	0 - 2	7.3	0.518	44	4.5	1.3	0.28	0.16	48	33	19	L	15
0398S04922	GW-9	0 - 2	7.2	0.485	37	3.9	1.2	0.37	0.23	52	30	18	SL	8.8

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

Andalex Resources, Inc.
Price, UT

Client Project ID: Genwal/Himonas
Date Received: 08/26/98

IML Project #0398S04914
Report Date: 09/18/98

Lab Id	Sample Id	Depths Feet	Boron Soluble mg/Kg	Selenium AB-DTPA mg/Kg	TKN %	Nitrogen Nitrate mg/L	TOC %	Organic Matter %	Exch. Sodium %	1/3 bar water %	15 bar water %
0398S04914	GW-1	0 - 2	0.3	<0.01	0.15	0.7	2.2	3.8		24.2	10.8
0398S04915	GW-2	0 - 2	0.3	<0.01	0.13	0.5	2.2	3.8		21.0	13.3
0398S04916	GW-3	0 - 2	0.4	<0.01	0.20	0.7	2.7	4.7		24.0	16.7
0398S04917	GW-4	0 - 2	0.3	<0.01	0.14	0.5	2.5	4.3		21.9	11.4
0398S04918	GW-5	0 - 2	0.5	<0.01	0.23	2.6	2.9	4.9		27.9	15.5
0398S04919	GW-6	0 - 2	0.2	<0.01	0.21	0.7	2.9	4.9		27.2	16.7
0398S04920	GW-7	0 - 2	<0.2	<0.01	0.12	2.0	2.2	3.8		22.1	9.9
0398S04921	GW-8	0 - 2	0.3	<0.01	0.15	0.6	2.3	3.9		23.5	10.1
0398S04922	GW-9	0 - 2	0.2	0.02	0.10	1.0	1.8	3.1		19.6	8.4

Inter-Mountain Laboratories, Inc.

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

Andalex Resources, Inc.

Price, UT

Crandall Canyon Mine

Client Project ID: Genwal Resources

Date Received: 11/05/98

IML Project #0398S06536

Report Date: 11/30/98

Lab Id	Sample Id	Depths	pH	EC	Saturation	Ca	Mg	Na	SAR	Sand	Silt	Clay	Texture USDA	Very Fine Sand
		inch	s.u.	mmhos/cm	%	meq/L	meq/L	meq/L		%	%	%		%
0398S06536	CC1	0 - 5	7.6	1.05	40	3.9	2.0	7.5	4.4	54	29	17	SL	15
0398S06537	CC1	5 - 10	7.8	1.64	31	3.3	1.2	19	13	66	26	18	SL	16
0398S06538	CC1	10 - 26	8.2	0.94	28	9.0	1.3	12	5.5	52	25	23	SCL	13
0398S06539	CC1	26 - 45	8.3	0.80	28	7.7	1.4	10	4.9	54	25	21	SCL	14
0398S06540	CC2	0 - 8	7.8	0.66	33	5.7	1.3	0.78	0.42	66	25	19	SL	12
0398S06541	CC2	8 - 15	7.7	0.55	35	4.7	1.2	0.71	0.42	66	24	20	SCL	11
0398S06542	CC2	15 - 40	7.8	1.90	38	12	6.6	3.2	1.1	68	21	21	SCL	9
0398S06543	CC3	0 - 9	7.7	0.62	38	5.5	1.0	0.50	0.28	66	27	17	SL	14
0398S06544	CC3	9 - 29	7.8	0.57	39	4.7	0.97	0.70	0.42	54	27	19	SL	11
0398S06545	CC3	29 - 54	8.2	0.58	26	1.9	4.1	1.4	0.80	52	37	11	SL	18
0398S06546	CC4	0 - 8	7.3	0.72	34	8.2	1.2	0.50	0.26	62	25	13	SL	14
0398S06547	CC4	8 - 25	7.4	0.72	35	6.9	1.4	0.63	0.31	60	23	17	SL	14
0398S06548	CC4	25 - 43	7.7	0.44	33	4.6	1.3	0.82	0.48	58	25	17	SL	14
0398S06549	CC5	0 - 10	7.4	0.64	35	6.4	0.69	0.39	0.21	68	21	11	SL	12
0398S06550	CC5	10 - 26	7.8	0.36	25	3.1	0.72	0.48	0.35	88	7	5	S	3
0398S06551	CC5	26 - 44	7.8	0.40	33	3.1	1.4	0.87	0.58	64	19	17	SL	11
0398S06552	CC6	0 - 7	8.9	1.08	41	12	1.6	0.51	0.20	68	19	13	SL	13
0398S06553	CC6	7 - 17	7.2	0.93	48	10	1.5	0.55	0.23	64	21	15	SL	14
0398S06554	CC6	17 - 42	7.5	1.68	34	13	5.6	2.9	0.94	68	17	15	SL	14

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

Andalex Resources, Inc.

Price, UT

Crandall Canyon Mine

Client Project ID: Genwal Resources

Date Received: 11/05/98

IML Project #0398S06536

Report Date: 11/30/98

Lab Id	Sample Id	Depths	CaCO3	Boron Soluble	Selenium AB-DTPA	TKN	Nitrogen Nitrate	TOC	Organic Matter	1/3 bar water	15 bar water
		inch	%	mg/Kg	mg/Kg	%	mg/L	%	%	%	%
0398S06536	CC1	0 - 5	15	1.0	<0.01	0.24	<0.2	2.1	3.6	21.8	12.5
0398S06537	CC1	5 - 10	15	0.8	<0.01	0.15	<0.2	1.6	2.7	21.3	11.2
0398S06538	CC1	10 - 26	17	<0.4	<0.01	0.09	<0.2	1.1	1.9	21.6	11.9
0398S06539	CC1	26 - 45	17	<0.4	<0.01	0.08	<0.2	0.9	1.6	20.8	11.6
0398S06540	CC2	0 - 8	26	0.5	<0.01	0.13	1.2	1.6	2.8	17.3	9.3
0398S06541	CC2	8 - 15	23	<0.4	<0.01	0.11	1.2	1.2	2.1	16.7	9.8
0398S06542	CC2	15 - 40	33	<0.4	<0.01	0.07	<0.2	0.7	1.3	18.1	10.8
0398S06543	CC3	0 - 9	24	0.4	<0.01	0.14	<0.2	1.3	2.2	18.9	10.0
0398S06544	CC3	9 - 29	25	<0.4	<0.01	0.10	1.1	1.1	1.8	17.7	11.0
0398S06545	CC3	29 - 54	31	0.4	<0.01	0.02	1.4	0.2	0.3	14.6	5.1
0398S06546	CC4	0 - 8	16	<0.4	<0.01	0.14	1.3	1.6	2.7	16.3	6.8
0398S06547	CC4	8 - 25	22	<0.4	0.02	0.12	1.6	1.2	2.0	17.1	8.1
0398S06548	CC4	25 - 43	25	<0.4	0.02	0.09	1.1	1.0	1.7	14.6	7.3
0398S06549	CC5	0 - 10	13	<0.4	0.02	0.10	1.6	1.4	2.4	15.9	7.1
0398S06550	CC5	10 - 26	16	<0.4	0.01	0.02	<0.2	0.2	0.3	6.2	2.1
0398S06551	CC5	26 - 44	14	<0.4	<0.01	0.07	1.0	0.7	1.3	15.5	6.6
0398S06552	CC6	0 - 7	11	<0.4	0.01	0.15	1.2	1.8	3.2	18.4	10.2
0398S06553	CC6	7 - 17	12	<0.4	<0.01	0.19	1.4	2.2	3.8	23.1	13.4
0398S06554	CC6	17 - 42	11	<0.4	<0.01	0.07	1.0	1.1	1.8	18.3	7.2

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

Andalex Resources, Inc.
Price, UT
Crandall Canyon Mine

Client Project ID: Genwal Resources
Date Received: 11/05/98

IML Project #0398S06536
Report Date: 11/30/98

Lab Id	Sample Id	Depths	pH	EC	Saturation	Ca	Mg	Na	SAR	Sand	Silt	Clay	Texture USDA	Very Fine Sand
		Inch	s.u.	mmhos/cm	%	meq/L	meq/L	meq/L		%	%	%		%
0398S06539	CC1	26 - 45	8.3	0.80	28	7.7	1.4	10	4.9	54	25	21	SCL	14
0398S06539D	CC1	26 - 45	8.3	0.80	32	7.8	1.4	11	5.0	54	25	21	SCL	13
0398S06561	CC5	26 - 44	7.8	0.40	33	3.1	1.4	0.87	0.58	64	19	17	SL	11
0398S06561D	CC5	26 - 44	7.8	0.41	33	3.1	1.4	0.93	0.62	64	20	16	SL	11

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

Andalex Resources, Inc.

Price, UT

Crandall Canyon Mine

Client Project ID: Genwal Resources

Date Received: 11/05/98

IML Project #0398S06536

Report Date: 11/30/98

Lab Id	Sample Id	Depths	CaCO3	Boron Soluble	Selenium AB-DTPA	TKN	Nitrogen Nitrate	TOC	Organic Matter	1/3 bar water	15 bar water
		Inch	%	mg/Kg	mg/Kg	%	mg/L	%	%	%	%
0398S06539	CC1	26 - 45	17	<0.4	<0.01	0.08	<0.2	0.9	1.6	20.8	11.6
0398S06539D	CC1	26 - 45	17	<0.4	<0.01	0.08	<0.2	0.9	1.6	21.3	11.4
0398S06551	CC5	26 - 44	14	<0.4	<0.01	0.07	1.0	0.7	1.3	15.5	6.6
0398S06551D	CC5	26 - 44	13	<0.4	<0.01	0.07	1.0	0.8	1.3	15.9	6.6

Fax Cover Sheet

kinko's

226 East Harmony Road
Fort Collins, Colorado 80525
Tel: (970) 223-3915
Fax: (970) 223-3519

Date: 3-1-02

To: DAVE SHAVER

Company: WEST RIDGE RESOURCES

Fax: 435 564 4002

From: JIM NYENHUIS

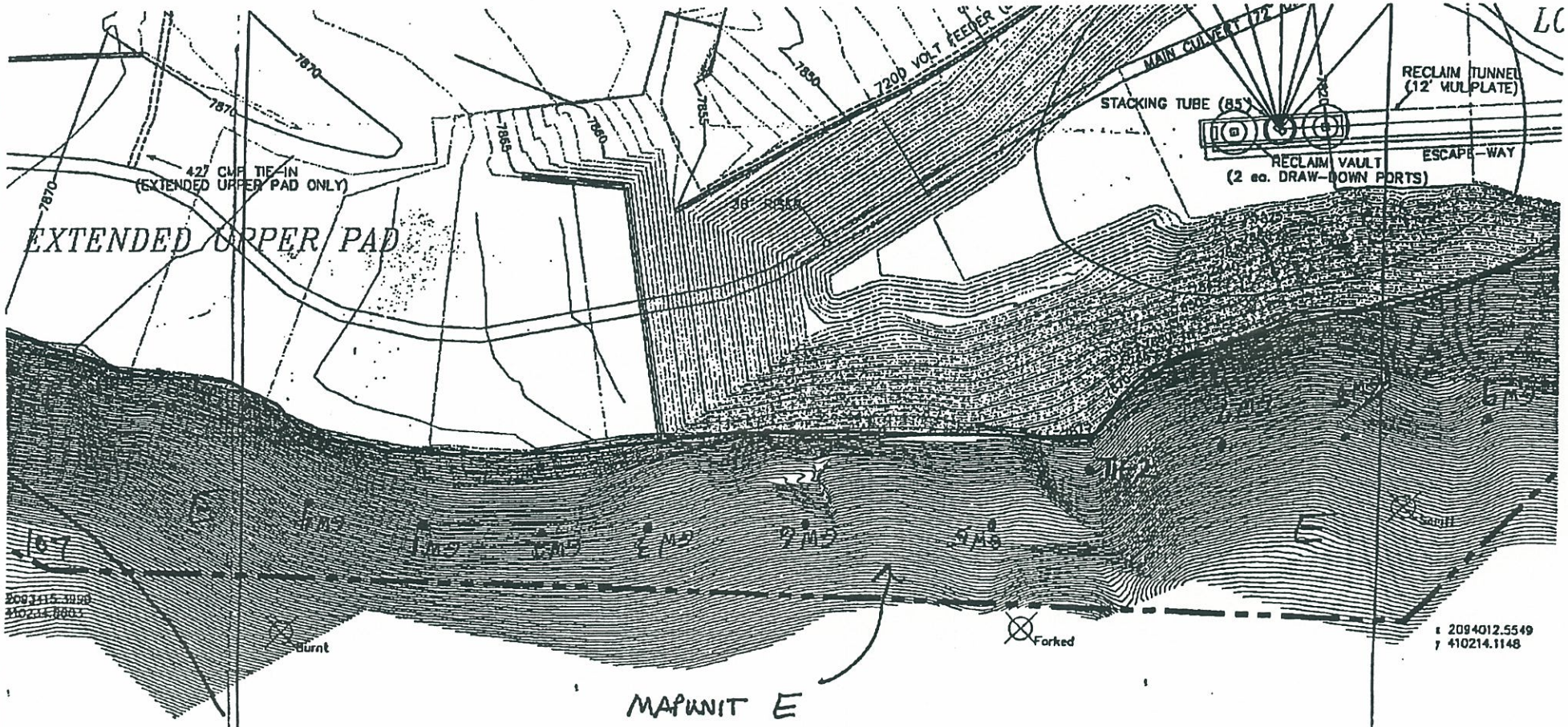
Company: SOIL SCIENTIST

Tel: 970 204 9167

Number of pages including this one: _____

Comments:

north slope
Crandal Canyon
soils



LEGEND:

JERSEY BARRIER

EXISTING ROAD LIMITS

Fax Cover Sheet

kinko's
226 East Harmony Road
Fort Collins, Colorado 80525
Tel: (970) 223-3915
Fax: (970) 223-3519

Date: 3-2-02

To: DAVE SHAVER

Company: WEST RIDGE RESOURCES

Fax: 435 564 4002

From: JIM NYENHUIS

Company: SOIL SCIENTIST

Tel: 970 204 9167

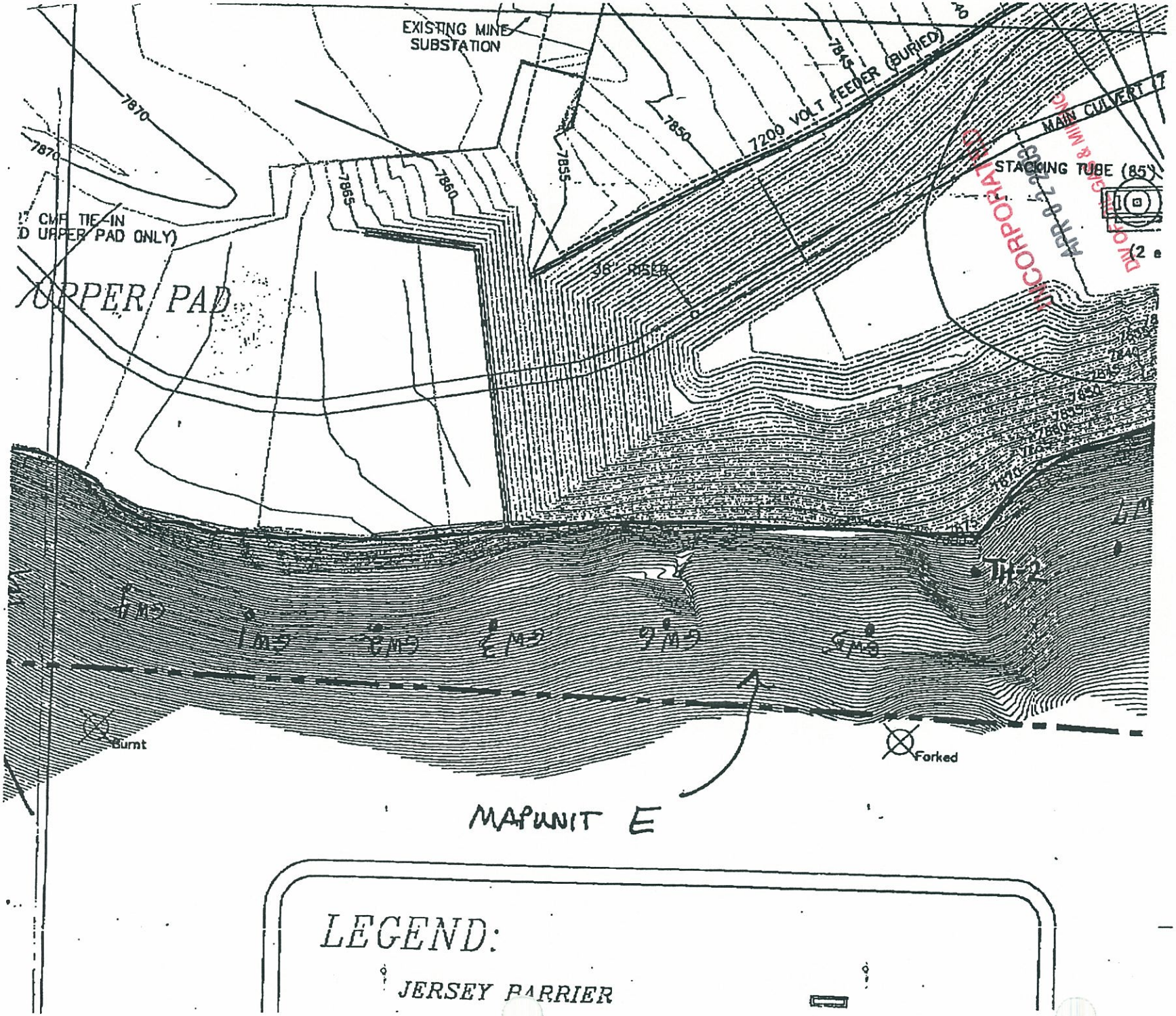
Number of pages including this one: _____

Comments:

I am refaxing the map in 2 parts to make sure you get it all.

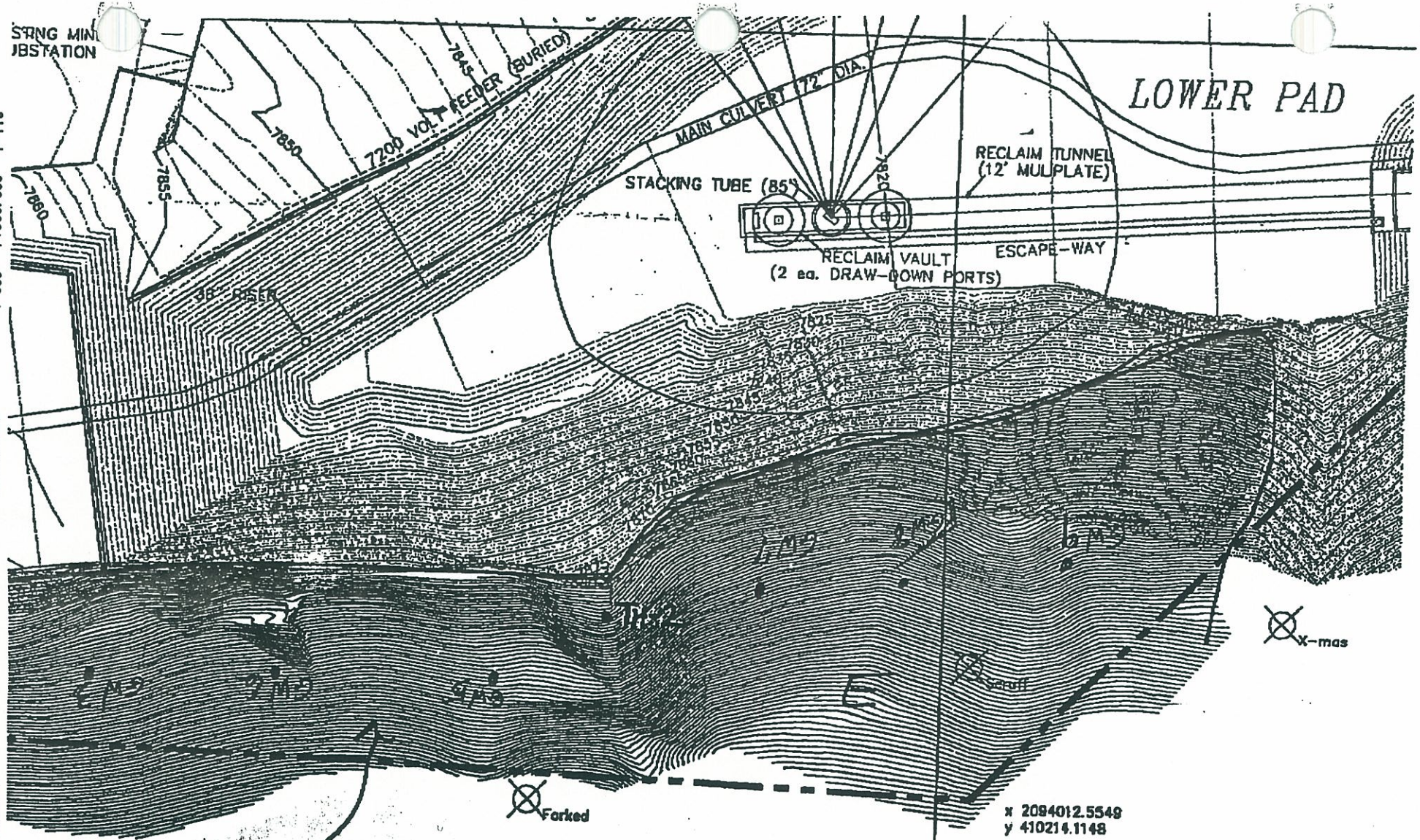
Jim N.

Call if you need to.



LEGEND:

JERSEY BARRIER



Mar-02-2002 10:15am From-KINKO'S T-385 P.003/003 F-115 +9702233518

END:

ERSEY BARRIER

APPENDIX 2-7

GEOTEXTILE PROPERTIES

4/05/2003

The geotextile fabric will have the following minimum properties:

MECHANICAL PROPERTIES		UNITS
Grab Tensile Strength		
ASTM D 4632		
MD @ Utlimate	0.89 (200	kN (lbs)
CMD @ Ultimate	0.89 (200	kN (lbs)
MD/CMD Elongation @ Ultimate		
Mullen Burst Strength		
ASTM D 3786	2756 (400)	kPa (psi)
Trapeziodal Tear Strength		
ASTM D 4833	0.33 (75)	kN (lbs)
Puncture Strength		
ASTM D 4833	0.40 (90)	kN (lbs)
UV Resistance after 500 hrs.		
ASTM D 4355	70	% Strength
HYDRAULIC PROPERTIES		
Apparent Opening Size		
ASTM D 4751	0.300 (50)	mm(US sieve)
Permittivity	0.05	sec-1

This type of geotextile was chosen because of its strength characteristics and is longevity. According to the manufacturer's representatives the strength of the geotextile is not affected by moisture, or contact with earthen materials. In a buried condition away from the harmful exposure to ultraviolet radiation, the geotextile is expected to retain essentially all of its original strength even after 20 years of service. In fact, the geotextile is manufactured specifically for such permanent, long life situations such as under highways, railroad grades, dams and other similar applications. Care will be taken te ensure that the geotextile is properly overlapped and secured at the edges to provide total areal coverage in accordance with manufacturers recommended installation instructions.

4/05/2003

APPENDIX 2-8

LABORATORY ANALYSIS
NATIVE FILL AND IMPORTED FILL

4/05/2003

APPENDIX 2-8

LABORATORY ANALYSIS
NATIVE FILL AND IMPORTED FILL

Table 1: Laboratory Results from Soil Sampling at the Crandall Canyon Mine: South Portal (Dec. 2002)

Parameter	Results	Criteria
Texture	Sandy Loam	Good
Total Organic Carbon (%)	<0.1	Good
Acid Base Potential (Tot. S ABP t/1000t)	207	Acceptable
pH	7.2	Good
Saturation %	23.1	Poor
Electrical Conductivity (mmhos/cm @ 25°C)	5.25	Fair
Available Water Capacity (in./in.)	0.04+	Poor to Fair
Sodium Adsorption Ratio	3.96	Good
Boron (ppm)	0.28	Acceptable
Selenium (ppm)	0.08	Acceptable
Soil sampling done by West Ridge Resources, East Carbon, UT Lab work & parameters requested by West Ridge Resources, East Carbon, UT Laboratory analyses by Inter-Mountain Laboratories, Inc., Sheridan, WY Analyses interpretations by Mt. Nebo Scientific, Inc., Springville, UT		

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

West Ridge Resources, Inc.
794 North "C" Canyon Road
East Carbon, UT 84520

Client Project ID: Topsoil
Date Received: 12/17/02

Set #0102S25050
Report Date: 12/30/02

Lab Id	Sample Id	pH	Saturation	EC @ 25°C	Calcium	Magnesium	Sodium	SAR
		s.u.	%	mmhos/cm	meq/L	meq/L	meq/L	
0102S25050	So. Portals Fill	7.2	23.1	5.25	17.0	31.4	19.5	3.96
~~0102S25051~~	~~Highwall Fill~~	~~7.1~~	~~24.7~~	~~1.19~~	~~5.87~~	~~5.11~~	~~2.11~~	~~0.69~~

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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

Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

West Ridge Resources, Inc.
794 North "C" Canyon Road
East Carbon, UT 84520

Client Project ID: Topsoil
Date Received: 12/17/02

Set #0102S25050
Report Date: 12/30/02

Lab Id	Sample Id	Coarse Fragments	Sand	Silt	Clay	Texture	TOC	Total Sulfur	T.S. AB	Neutral. Pot.	T.S. ABP
		%	%	%	%		%	%	t/1000t	t/1000t	t/1000t
0102S25050	So. Portals Fill	66.5	70.0	17.0	13.0	SANDY LOAM	<0.1	0.02	0.62	208	207
~~0102S25051~~	~~Highwall Fill~~	~~66.0~~	~~69.0~~	~~15.0~~	~~16.0~~	~~LOAM~~	~~1.0~~	~~0.01~~	~~0.66~~	~~744~~	~~744~~

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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

Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

West Ridge Resources, Inc.
794 North "C" Canyon Road
East Carbon, UT 84520

Client Project ID: Topsoil
Date Received: 12/17/02

Set #0102S25050
Report Date: 12/30/02

Lab Id	Sample Id	Available Sodium	Exchangeable Sodium	Boron	Nitrogen Nitrate	Selenium	TKN
		meq/100g	meq/100g	ppm	ppm	ppm	%
0102S25050	So. Portals Fill	0.72	0.27	0.28	1.10	0.08	0.03
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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

Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

APPENDIX 2-9

LETTER REGARDING
NOXIOUS WEEDS IN FILL

4/05/2003

Michael O. Leavitt
Governor
Cary G. Peterson
Commissioner

State of Utah

DEPARTMENT OF AGRICULTURE
GOVERNOR'S CABINET

350 North Redwood Road
Salt Lake City, Utah 84116-3087
(801) 538-7100
(801) 538-7126 FAX

January 27, 2003

Genwal Resources
PO Box 1077
Price, Ut 84501

Dear Gary Gray:

On January 13, 2003, I inspected the gravel pit of Nielsen Construction located at 2000 W Canyon Rd. west of Huntington, Utah. The purpose of my inspection was to see if any noxious weed were growing in the area of the gravel pit. I did not see any noxious weeds or remnants of noxious weeds within the pit or within 300 ft. surrounding the pit area.

Mr. Kevin Peacock, crusher manager for Nielsen Construction explained that the top three feet of soil is removed and piled in an area about 300 yards west of the pit before the fill dirt is removed.

Sincerely,

Carl Bott
Comp. Specialist
Utah Department of Agriculture & Food

APPENDIX 2-10

LETTER REGARDING PRIME FARMLAND

GENWAL™ RESOURCES, INC.

P.O. BOX 1077
PRICE, UTAH 84501
PHONE: (435) 564-4000
FAX: (435) 564-4002

September 9, 2003

Mr. Leland Sasser
NSCS
Price UT 84501

Re: Genwal South Crandall Tract

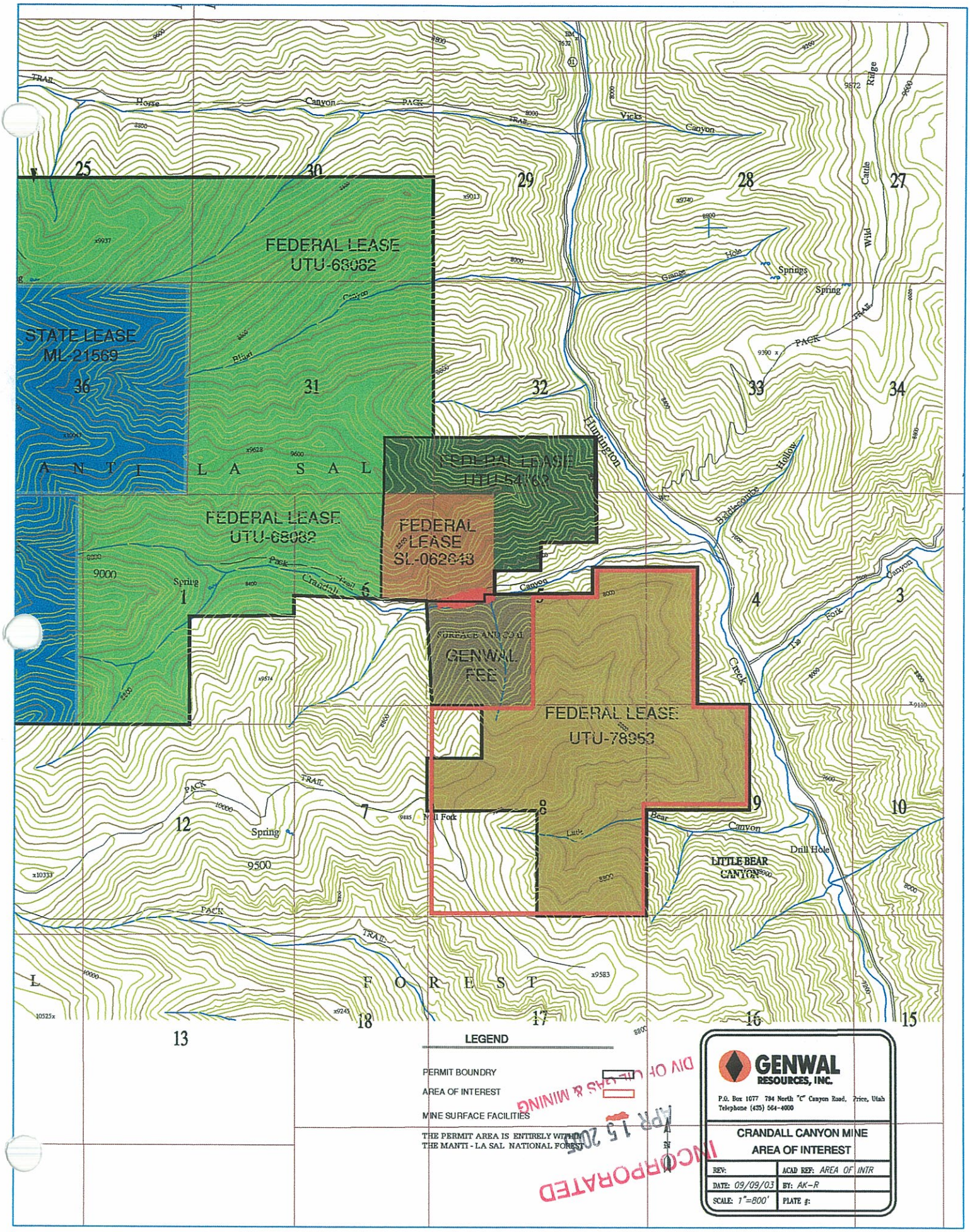
Dear Mr. Sasser:

GENWAL RESOURCES, INC. has applied for a mining permit on a tract of land adjacent to its Crandall Canyon Mine. I talked to you in late June about a determination of prime farmland and alluvial valley floor of the area, the South Crandall Tract. The Division of Oil, Gas and Mining requires a letter from you to GENWAL RESOURCES, INC. about your determination of the area. In order to help expedite your review for DOGM, I am enclosing the outline of the tract (Federal Lease UTU-78953) on the Rilda Canyon USGS quadrangle topographical map.

Call me at 435-564-4015 if you have any questions.

Sincerely

Gary E. Gray
Engineer


FEDERAL LEASE
UTU-68082
STATE LEASE
ML-21569
FEDERAL LEASE
UTU-68082
FEDERAL LEASE
SL-062843
FEDERAL LEASE
UTU-78953
SURFACE AND COAL
GENWAL
FEE
A N T I L A S A L
F O R E S T
Horse Canyon
Vicks Canyon
Cattle Wild Horse Springs
Spring
Huntington Canyon
Bradycomice Hollow
Crandall Canyon
Pack Trail
Spring
Spring
Mill Fork
Little Bear Canyon
Drill Hole
LITTLE BEAR CANYON
25
30
29
28
27
36
31
32
33
34
1
6
4
3
12
7
9
10
13
18
17
16
15
LEGEND
PERMIT BOUNDRY
AREA OF INTEREST
MINE SURFACE FACILITIES
THE PERMIT AREA IS ENTIRELY WITHIN
THE MANTI - LA SAL NATIONAL FOREST
DIV OF OIL GAS & MINING
APR 15 2005
INCORPORATED
GENWAL
RESOURCES, INC.
P.O. Box 1077 794 North "C" Canyon Road, Price, Utah
Telephone (435) 564-4000
CRANDALL CANYON MINE
AREA OF INTEREST
REV:
ACAD REF: AREA OF INTR
DATE: 09/09/03
BY: AK-R
SCALE: 1"=800'
PLATE #: