GENWAL MINE
015/032

MINING AND RECLAMATION PLAN

for the
CRANDALL CANYON #1 MINE
and the
SOUTH CRANDALL MINE

CHANGE TO THE RECLAMATION PLAN
FOR THE

CRANDALL CANYON MINE MEMORIAL
and the
PORTAL WATER DISCHARGE

TASK # 2957

SUBMITTED: December 8 , 2008

CHAPTER 5

FIGURES

(Note: Unless otherwise noted, figures follow Chapter 5 text)

CHAPTER 5

LIST OF APPENDICES (continued)

APPENDIX NUMBER	DESCRIPTION
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5-17	Road Expansion (within permit area) Safety Factor, Drawings
5-18	Fire Prevention Plan
5-19	Slope Stability Investigation Portal Pad
5-20	Bond Estimate (DOGM determination)
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5-24	R2P2 (Resource Recovery and Protection Plan) Approval Letter (South Crandall Federal Lease UTU-78953)
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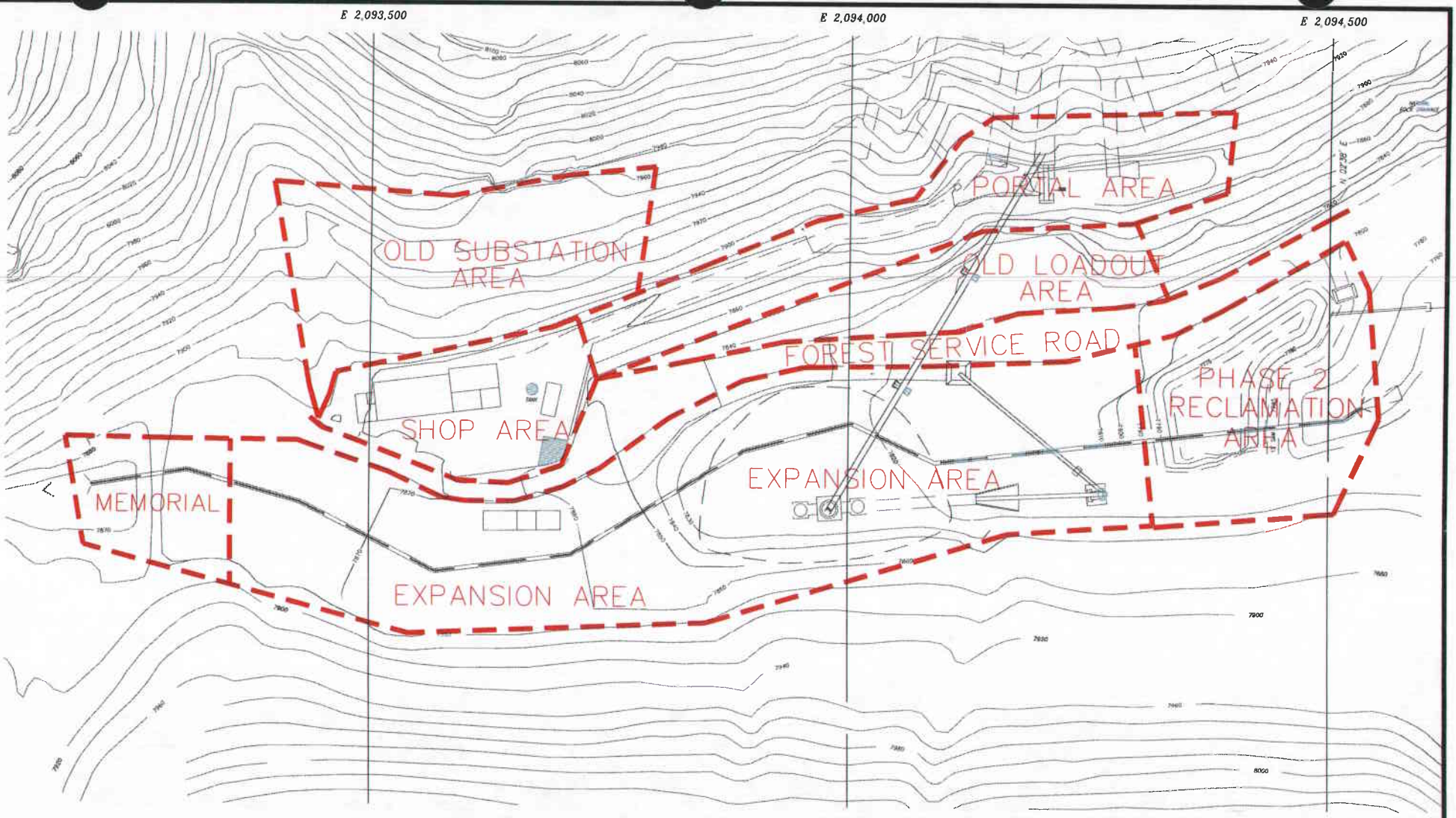
5-25	Subsidence Survey Letters of Notification
5-26	Forest Service Trailhead Parking Arrangement
5-27	Crandall Canyon Mine Memorial, Emery County, Memorandum of Agreement



RECLAMATION AREAS

Crandall Canyon Mines
Crandall Canyon Mine
P.O. BOX 910
EAST CARBON, UTAH 84520

DRAWN BY: PJJ	DATE: 12/04/08
SCALE: AS SHOWN	REVISION: 2
SHEET: FIGURE 1	

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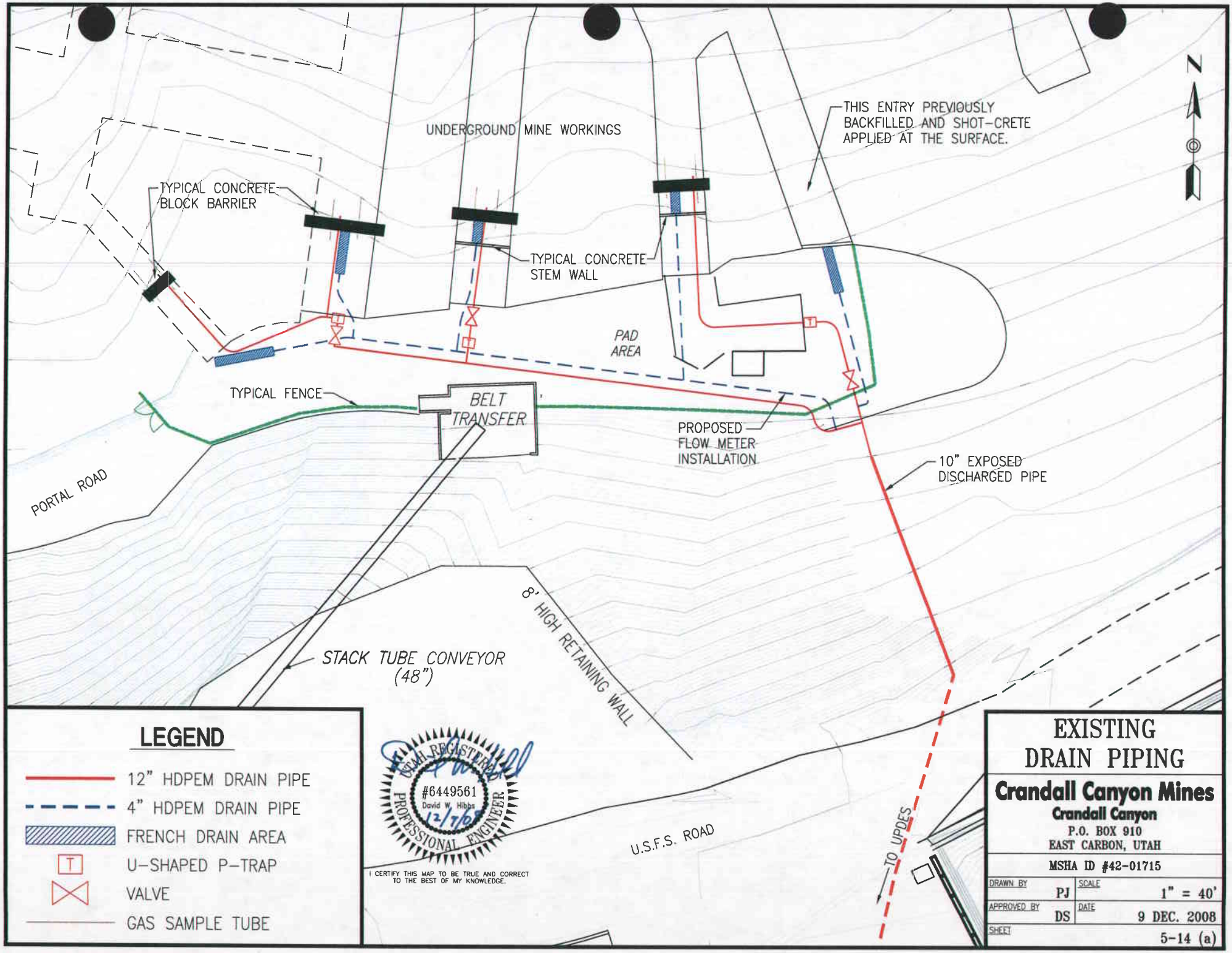
FIGURE 5-14

PORTAL & DISCHARGE WATER RECLAMATION DRAWINGS

a) Existing Plan View
b) Reclamation Plan View
c) Reclamation Cross-Section View



LEGEND

- 12" HDPEM DRAIN PIPE
- 4" HDPEM DRAIN PIPE
- FRENCH DRAIN AREA
- T — U-SHAPED P-TRAP
- VALVE
- GAS SAMPLE TUBE

STATE OF UTAH REGISTERED #6449561 David W. Hibbs 12/7/08 PROFESSIONAL ENGINEER

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

EXISTING DRAIN PIPING

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	1" = 40'
APPROVED BY	DS	DATE	9 DEC. 2008
SHEET			5-14 (a)

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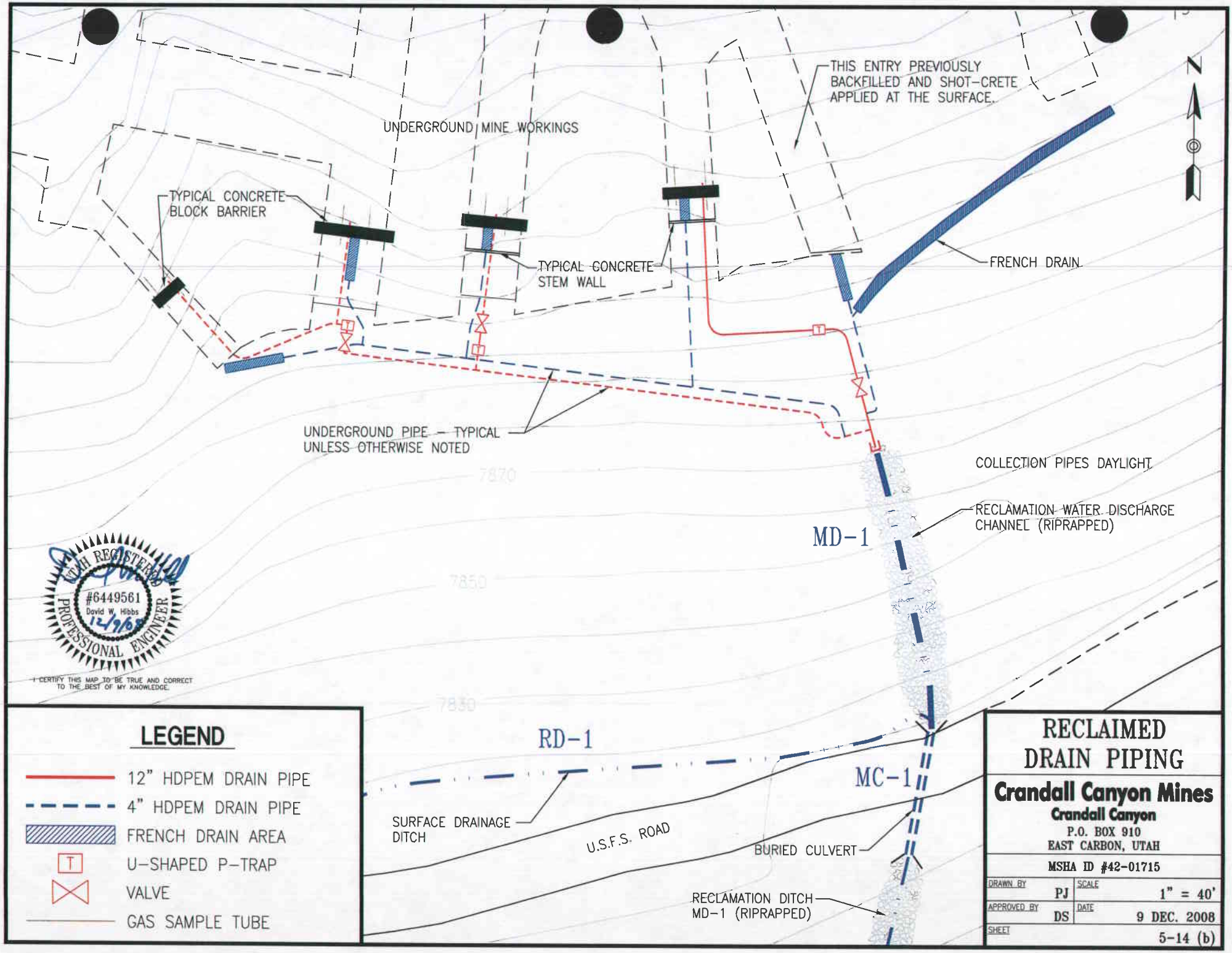

UTAH REGISTERED
#6449561
David W. Hibbs
12/9/08
PROFESSIONAL ENGINEER

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

LEGEND

- 12" HDPEM DRAIN PIPE
- 4" HDPEM DRAIN PIPE
- FRENCH DRAIN AREA
- T — U-SHAPED P-TRAP
- VALVE
- GAS SAMPLE TUBE

RECLAIMED DRAIN PIPING

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	1" = 40'
APPROVED BY	DS	DATE	9 DEC. 2008
SHEET			5-14 (b)

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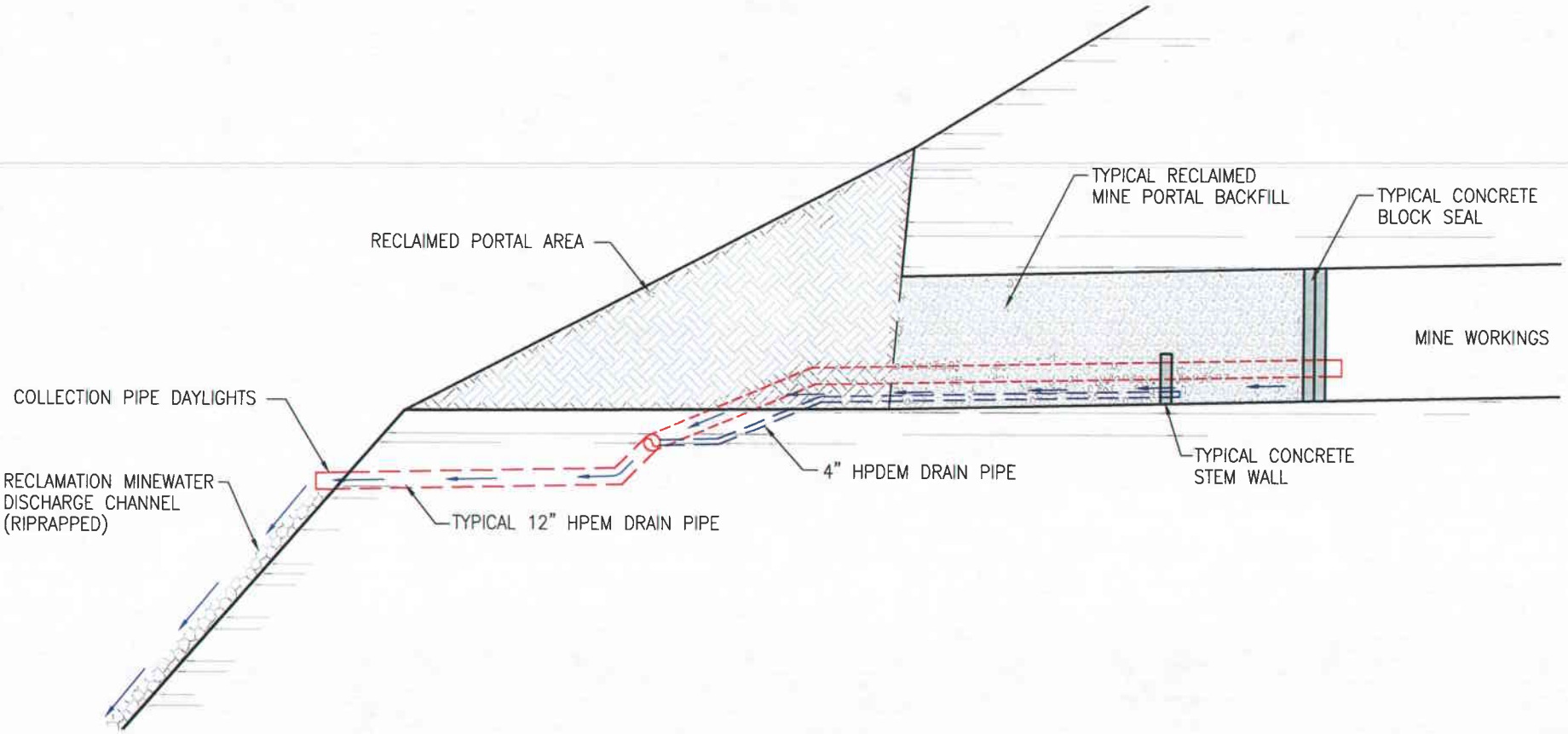

UTAH REGISTERED
#6449561
David W. Hibbs
12/9/08
PROFESSIONAL ENGINEER

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

TYPICAL RECLAIMED PORTAL SECTION

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY: PJ	SCALE: 1" = 10'
APPROVED BY: DS	DATE: 9 DEC. 2008
SHEET:	5-14 (c)

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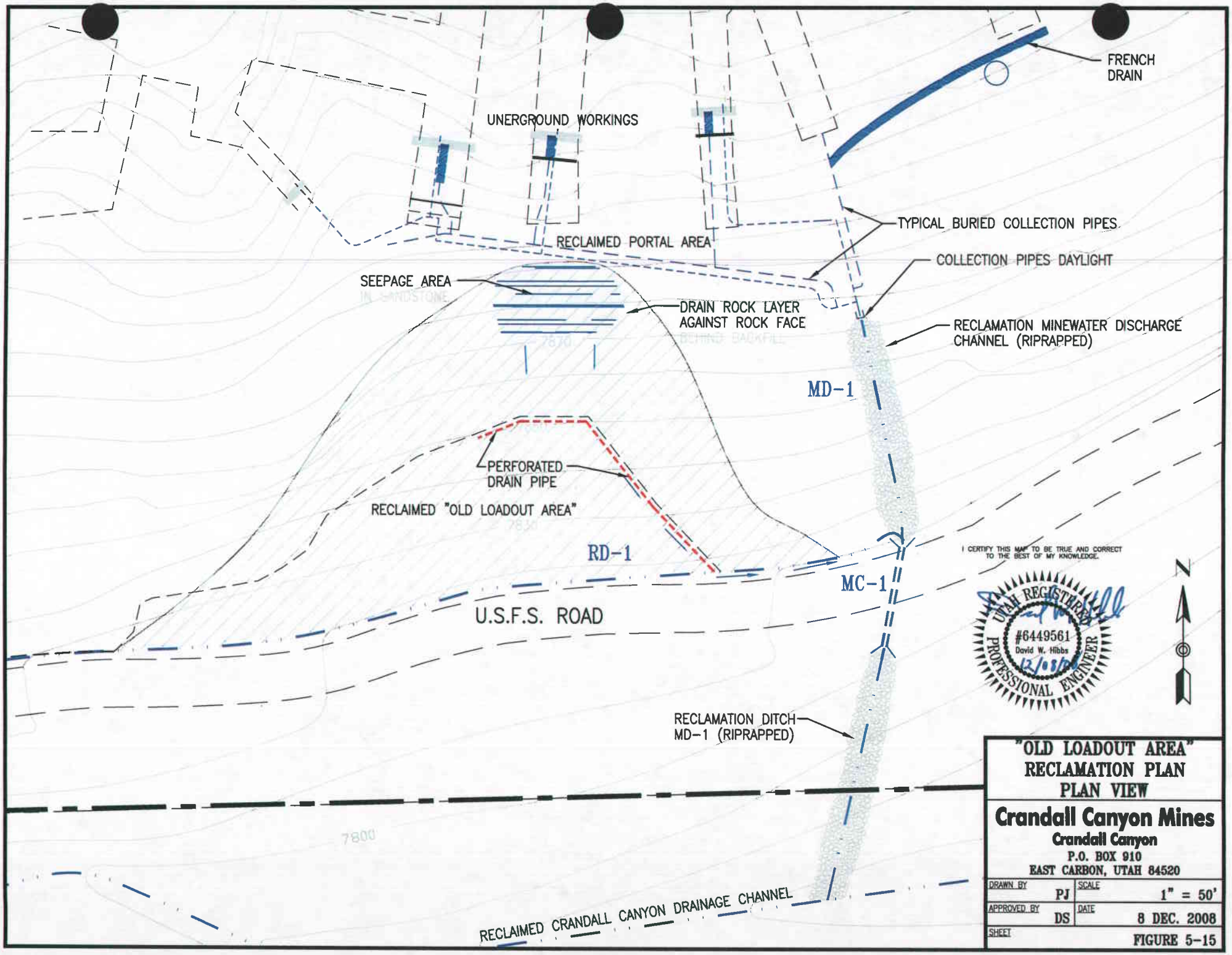
FIGURE 5-15

"OLD LOADOUT AREA"
RECLAMATION DRAWING

a) Plan View
b) Cross-Section View



"OLD LOADOUT AREA"
RECLAMATION PLAN
PLAN VIEW

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH 84520

DRAWN BY: PJ	SCALE: 1" = 50'
APPROVED BY: DS	DATE: 8 DEC. 2008
SHEET:	FIGURE 5-15

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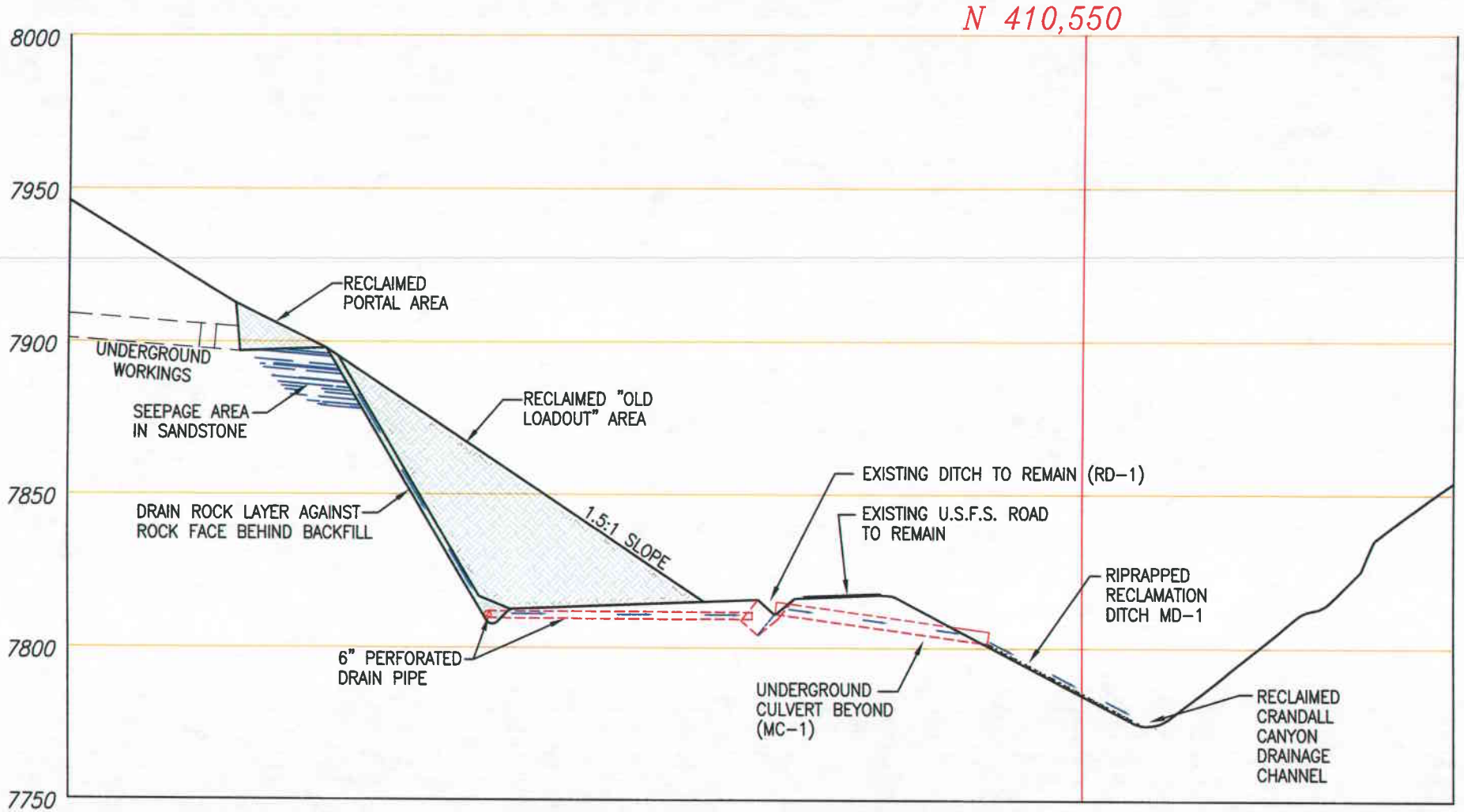

CROSS SECTION VIEW - LOOKING DOWNCANYON

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

UTAH REGISTERED #6449561 David W. Hibbs 12/8/08 PROFESSIONAL ENGINEER

"OLD LOADOUT AREA" RECLAMATION PLAN CROSS SECTION VIEW

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH 84520

DRAWN BY: PJ	SCALE: 1" = 50'
APPROVED BY: DS	DATE: 8 DEC. 2008
SHEET:	FIGURE 5-15

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APPENDIX 5-20

RECLAMATION COST ESTIMATE FOR THE BOND AMOUNT

(Note: Add the following page in front of the calculations)

APPENDIX 5-22

CRANDALL CANYON MINE SITE RECLAMATION PLAN

CRANDALL CANYON MINE SITE RECLAMATION PLAN

Phase 1

The reclamation of the disturbed areas of the Crandall Canyon mine site is described in outline and detail below. This description is based upon discussions in the text of Chapters 2, 3, 4, 5, 7 which address the regulations regarding reclamation requirements. In the interest of clarity, the following discussion describes the reclamation process in terms of several general areas within the mine yard. Refer to Figure 1 in this Appendix. Within each of these general areas, reclamation will follow a general sequence of 1) demolition, 2) backfilling, grading and topsoil application, 3) reclamation and revegetation. However, in practice, reclamation will be performed in several of these areas simultaneously. The final step, reclamation and revegetation, for all the areas will not be done until the fall.

Following Phase 1 reclamation, the only structures to remain will be the sedimentation pond and associated spillway and discharge structure as well as the conveyance ditches, berms and culverts necessary to route drainage to the pond. Refer to Plates 5-16 and 7-5 for location of these structures.

Genwal recognizes that development of a feasible reclamation plan for final reclamation of the expansion area containing the best available reclamation methodology is an essential part of this permitting process. Therefore, Genwal has contacted consultants with revegetation and reclamation experience to gather together the best reclamation techniques for reclamation of the steep-slope area. JBR Environmental Consultants, who has had prior experience with reclamation in difficult areas, has provided a letter detailing reclamation methodology that they believe will contribute to the successful reclamation of this area. This letter, included as Attachment 1, was written in response to Genwal's discussions held with JBR as the reclamation plan was being revised. Genwal feels that incorporation of the various reclamation techniques that JBR has identified as being successful in past situations will greatly enhance the success of this reclamation effort. Genwal also recognizes that in the time between now and when final reclamation is actually done, technology may evolve new and better reclamation ideas. Genwal commits to modifying the reclamation plan prior to final reclamation should better reclamation products and methodology become available. This reclamation plan will be reviewed prior to implementation to incorporate applicable methodology and techniques which are considered best technology currently available (BTCA) at the time of reclamation.

Area Descriptions

The reclamation plan has been divided into several general areas for the purpose of explanation. It is likely that reclamation efforts will occur in multiple areas during the same time interval. These areas are depicted on Figure 1 and described in summary below.

Portal Area: The Portal Area consists of an inclined access road, the mine portals leading into the underground mine, and structures in this area.

Expansion Area: In 1997, the surface facilities will have been expanded to the area south of the Forest Service road by culverting approximately 1,500' of Crandall Canyon through a 72" bypass culvert. Earthen fill material will have been trucked in to construct the Expansion Area. The truck loadout facilities will have been relocated to the Expansion Area along with the Overhead Conveyor, Stacking tube, Reclaim Tunnel and Conveyor, Crusher Building, MCC Building, Substation, and other associated structures. The fill from the Expansion Area will be utilized during final reclamation to restore approximate original contour in areas of cuts and highwalls. This fill will consist of 8" x 0" earth and rock material obtained from an approved off-site borrow area.

The Expansion Area has been divided into a North Slope Expansion Area and South Slope Expansion Area for the purposes of the reclamation discussion. The North Slope Expansion Area is that area north of the existing Crandall Creek and south of the existing Forest Service road. The South Slope Expansion Area includes the steeper hillside located south of the existing Crandall Creek. Due to the steep slopes encountered on the South Slope, special reclamation procedures have been prescribed for this area. Much of the reclamation plan designed for the South Slope is based on input from reclamation specialists who have experience in steep-slope reclamation situations.

Old Substation Area: The Old Substation Area the pad that was originally constructed in the northern part of the mine yard above the shop for a substation. However, the substation was never constructed at this location. Other than an existing powerline, there are no facilities on this site to be removed and the area has had interim revegetation.

Old Loadout Area: The Old Loadout Area is located adjacent to and just north of the Forest Service road and the new loadout. This is the area where coal was previously stockpiled and loaded into trucks prior to construction of the 1997 expansion area.

Forest Service Road: The Forest Service Road runs east-west through the mine site. As a result of construction of the Crandall Canyon Memorial in the summer of 2008, part of this road was deeded to Emery County. The road is to be kept in place following reclamation activities but will undergo a change in width.

Shop Area: The Shop Area is located west of the mine portal area and north of the Forest Service Road. Facilities to be removed from the Shop area include: Shop/Warehouse building, Substation, Rock Dust Bin, Oil Shed and parking lot asphalt.

RECLAMATION PLAN OUTLINE

1. Demolition and Removal of Surface Facilities - Portal Area
2. Removal and Disposal of Expansion Area Fill Material
3. Seal and Backfill Portals
4. Backfill, Grade and Topsoil - Portal Area
5. Revegetation - Portal Area
6. Demolition - Old Substation Area
7. Backfill, Grade and Topsoil - Old Substation Area
8. Revegetation - Old Substation Area
9. Demolition and Removal of Surface Facilities - Shop Area
10. Backfill, Grade and Topsoil - Shop Area
11. Revegetation - Shop Area
12. Demolition and Removal of Surface Facilities - Old Loadout Area
13. Backfill, Grade and Topsoil - Old Loadout Area
14. Revegetate - Old Loadout Area
15. Reclaim Forest Service Road North of Expansion Area
16. Demolition and Removal of Surface Facilities - Expansion Area
17. Removal of Fill Material and Recontouring - Expansion Area
18. Restoration of South and North Hillside Slopes - Expansion Area
19. Revegetation - South Slope of Expansion Area
20. Removal and Disposal of 72" Culvert
21. Topsoiling - North Slope of the Expansion Area
22. Revegetation - North Slope of the Expansion Area
23. Restoration of the Stream Channel
24. Revegetation of the Stream Channel
25. Sediment Control and Treatment
26. Topsoil Stockpile Reclamation
27. Phase 2 Reclamation

Note: A Reclamation Timetable has been provided at the end of this discussion.

RECLAMATION PLAN DETAIL

1. Demolition and Removal of Surface Facilities - Portal Area

When mining operations have been permanently ceased and the portals and surface facilities are no longer needed to support the mine, all buildings and other structures will be dismantled and hauled off site to an approved landfill. Reusable materials will be salvaged and recycled to the extent possible.

At the Portal Area, facilities to be removed are: underground bath house, mine fan, fan transformer (portable), belt transfer station, guard rail at top and along access road, water pipelines, and the diversion culvert above portals.

The existing shotcrete above the portal road, above the portals and above the old coal loadout area, along with wire mesh, clips and other similar materials will be removed and disposed of in an appropriate state approved landfill.

All combustible materials will be removed from the underground bathhouse and hauled to an approved solid waste landfill. Any structures that would interfere with sealing of the portals, such as beltline structure, would also be removed.

Equipment used in the demolition and disposal of the facilities include: a front end loader, a backhoe, highway end dump trucks, a trackhoe, a crane, truck with flat bed trailer, oxy-acetylene torches, air compressor and power tools, etc.

2. Removal and Disposal of Expansion Area Fill Material

At the same time the structures in the portal area are being demolished and removed, the other surface facility structures located on the Expansion Area (truck loadout, conveyors, crusher building, etc.) will also be removed. Fill material, in excess of that needed for backfilling the Portal Area, Shop Area and Old Loadout Area (an estimated 61,532 loose cubic yards, Table 5-20-10 in Appendix 5-20) will be loaded, hauled and disposed of at an approved landfill.

The equipment used in the performance of this step would be a l-h-d unit (scoop), dozer w/ripper, and a front end loader.

3. Seal and Backfill Portals

The four portals on the north side are: bath house entrance, intake air entry, belt entry and fan (return air) entry. The three portals on the south side are the intake, belt and fan entries. The seals will be constructed approximately 25-35 feet inby from the portal openings and will be built according to MSHA regulations. Equipment necessary for sealing would be a cement mixer and hand tools. After finishing the construction of the seals, the 25 to 35 feet of entry from the portals to the seals will be backfilled with additional fill material from the Expansion Area.

4. Backfill, Grade and Topsoil - Portal Area

As a result of the Crandall Canyon Mine disaster of August 6, 2007, the portals of the mine were sealed. A system of drainpipes was also installed at the portals to collect and handle the mine discharge water. The mine is presently discharging about 600 gallons per minute, and this volume of discharge is expected to continue indefinitely. Figure 5-14 shows the details of the drain collection system. Presently, water from the four portals is collected into a common pipe which is piped down the hill and discharges into the main bypass culvert at an approved UPDES outfall point. There is also a small amount of water collected in a French drain outside one of the old portals from the old part of the mine (which is sealed off underground), which also reports to the main discharge pipe. All of the collection system is installed either within the portals inby the steel canopies, or else buried along the portal bench. It daylights from the buried installation and continues overland down the hill in an exposed pipe. It should also be noted that some seepage is presently coming from the old (sealed up) works below the existing collection system. This seepage has been ongoing since before the mine disaster, and reports to the sediment pond through a surface culvert. It should also be noted that a small amount of water is infiltrating into the Star Point Sandstone behind the mine seals and is seeping to the surface out of the ledge directly below the portals above the Old Loadout Area.

The reclamation plan acknowledges the water will continue to discharge from the mine (i.e., from the collection pipes, the old works, and the saturated sandstone) on a permanent basis. The company proposes to address the long-term discharge of mine water in the following manner: 1) backfill the portals, leaving the existing collection system in place, 2) construct an additional French drain system to collect the seepage water from the sealed up old works, 3) collect the seepage from the sandstone ledge with a drainrock/drainpipe system, and 4) replace the existing overland discharge pipe with an approved armored open channel. These are discussed individually as follows:

1) The existing collection system utilizes 10" heavy-wall PVC pipe extending back through the seals in all four portals. Additional 4" pipes also collect seepage water outside the seals which is entrapped behind specially constructed check dams. All piping is buried and was installed with plans to be part of the permanent post-reclamation discharge system. Upon reclamation, after the steel canopies have been removed, the portals will be completely backfilled as described below, leaving only the stub of pipe exiting to the surface at its present location. Figure 5-14 shows details of the existing pipe collection system.

2) A French drain is presently installed at the old portal of the old sealed works. However, because the old works are so close to the outcrop (in the area immediately east of the fan portal) there is a small but continuous seep of water along this area. Upon reclamation, the existing French drain will be extended eastward to pick up the additional water which is seeping to the outcrop. This seepage water will be routed into the main collection pipe prior to final discharge.

3) Under final reclamation the sandstone ledge below the portals (a.k.a. Old Loadout Area)

will be backfilled to approximate original contour as described in item 13 below. As explained above, due to the porous nature of this sandstone, it is now conveying a small but constant amount of mine water from behind the seals to the ledge outcrop below the portals. The seepage conduit is localized and can easily be contained during final reclamation. This will be done by installing a drain system between the ledge-rock and the backfilled slope which will collect the seepage water into a single discharge pipe. This will then be directed to join the main stream of discharge, so that all discharge enters into Crandall Creek at a common point . The details of this collection system are explained in item 13 (Old Loadout Area) below.

4) Presently, the discharge water is conveyed down from the portals down over the hill through a 12" PVC pipeline. This line then empties into an existing CMP culvert which leads to the main bypass culvert at an approved UPDES monitoring point. Upon final reclamation the PVC pipe would be replaced with an overland channel. In this area the sandstone bedrock lies very close to the surface, and forms natural outcrop ledges in the immediate and surrounding area. With a minor amount of work debris and weathered material can be removed to expose the competent bedrock below and thereby create a permanent, non-erosive channel for the discharge water course. In those areas where the weathered material is thicker, such as below the Forest Service Road (which will remain in place after mine reclamation) the channel would be lined with a suitable rip-rap. There would be no other flow in this channel other than the continuous 600 gpm mine discharge.

Once the portals have been sealed and backfilled, reclamation work can then commence on the Portal Area. This work consists of backfilling the cuts to approximate original contour, placing topsoil on the backfilled area and seeding the topsoiled area. Since the Portal Area (and the associated access road) is on a slope, this work will be done in short segments starting at the eastern-most (upper-most) portion of the area and working westward across the portal area and thence down the access road to the Shop Area. Fill material from the Expansion Area will be utilized to backfill and reclaim the highwall area. The fill material will contain rock fragments of all sizes, including a significant amount of 6" to 8" rock fragments. These rocks will assist in providing slope stability and aid revegetation by helping to retain moisture. The fill material will be topped with 12" of topsoil material to promote plant growth.

Mobile heavy equipment will be utilized to move and place fill in highwall and yard areas and the south portal pocket cuts. A front end loader and end dumps will be used to remove fill material from the Expansion Area and haul the material up to the Portal Area. The lifts will be built up horizontally with a slight slope on each lift toward the highwall. Material will be spread into lifts of 18 to 24 inches deep. The loader will compact each lift as the next lift is put in. A backhoe will be used to place and compact the final lift. Before placing topsoil on the final backfilled surface, that surface will be roughened with the backhoe bucket. This will help prevent slippage of the topsoil layer and promote root penetration.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the

topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil, prior to seeding, if a need is indicated by laboratory results. The fertilizer will be spread on the redistributed topsoil and either disked or hand-raked into the soil (depending on the steepness of the slope).

Areas to receive topsoil will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

5. Revegetation - Portal Area

Revegetation procedures for the Portal Area and the south portal pocket cuts involves a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will ~~be~~ certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

6. Demolition - Old Substation Area

The only structures existing at the Old Substation Area is the termination structure for the mine powerline. This powerline will be dismantled and removed from the site prior to completion of final reclamation.

7. Backfill, Grade and Topsoil - Old Substation Area

Fill from the Expansion Area will be hauled to the Old Substation Area for backfilling. The cut slope above the pad will be backfilled to the approximate original contour. The area will then be topsoiled and revegetated.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil

auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil as indicated by laboratory results of the most needful increment.

The areas to be topsoiled will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

8. Revegetation - Old Substation Area

Revegetation procedures for the Old Substation Area involves a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

9. Demolition and Removal of Surface Facilities - Shop Area

Facilities to be removed from the Shop area include: Shop/Warehouse building, Substation, Rock Dust Bin, Oil Shed and parking lot asphalt. All structures will be removed from the site. Some components will be salvaged and recycled. Non-salvageable material will be disposed of in an approved solid waste landfill. All asphalt removed from the site will be disposed on in an approved RCRA disposal site.

A portion of the retaining wall which separates the Shop Area from the Forest Service Road will be removed, loaded onto trucks and hauled to an approved landfill. That portion not removed will be buried under a minimum of four feet of backfill material.

Equipment used in the demolition and disposal of the facilities include: a front end loader, a backhoe, highway end dump trucks, a trackhoe, crane, truck with flat bed trailer, oxy-acetylene torches, air compressor and power tools, etc.

10. Backfill, Grade and Topsoil - Shop Area

With the Portal Area and Old Substation Area reclamation completed, and the retaining wall removed, the reclamation activities can continue at the Shop Area. Although this area is not

as steep as the previous areas, the same reclamation procedures will be used. The cut slope behind the shop will be backfilled to approximate original contour using fill material from the Expansion Area. The lifts will be built up horizontally with a slight incline on each lift toward the existing cut slope. The dozer/loader will spread the material in lifts of 18 to 24 inches deep. The mobile equipment will compact each lift as the next lift is put in. Near the top of the slope, a backhoe will be used to place and compact the final lift. Before placing topsoil on the final backfilled surface, the surface will be roughened with the backhoe bucket to prevent slippage of the topsoil layer and promote root penetration.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil as indicated by laboratory results of the most needful increment.

The areas to be topsoiled will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

11. Revegetation - Shop Area

Revegetation procedures for the Shop Area involves a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

12. Demolition and Removal of Surface Facilities - Old Loadout Area

At the time of final reclamation, the facilities at the Old Loadout Area will have already been removed and disposed of as part of the 1997 Surface Expansion Project. All asphalt removed from the site will be disposed on in an approved RCRA disposal site. A portion of the existing coal pile retaining wall will be removed, loaded onto trucks and hauled to an approved landfill. That portion not removed will be buried under a minimum of four feet of backfill material.

Equipment used in the demolition and disposal of the facilities include: a front end loader, a backhoe, highway end dump trucks, a trackhoe, crane, and truck with flat bed trailer.

13. Backfill, Grade and Topsoil - Old Loadout Area

With the retaining wall removed, reclamation activities can continue at the Old Loadout Area. The same reclamation procedures will be used as described previously. The cut slope behind the retaining wall will be backfilled to approximate original contour using fill material from the Expansion Area. The lifts will be built up horizontally with a slight incline on each lift toward the existing cut slope. The dozer/loader will spread the material in lifts of 18 to 24 inches deep. The mobile equipment will compact each lift as the next lift is put in. Near the top of the slope, a backhoe will be used to place and compact the final lift. Before placing topsoil on the final backfilled surface, the surface will be roughened with the backhoe bucket to prevent slippage of the topsoil layer and promote root penetration.

As noted in item 4 above, there is a small but continuous seepage of water coming out of the sandstone ledge below the portals. This seepage water will be collected into a parmanent drain system as part of final reclamation. Prior to backfilling, a 4" perforated drainpipe will be laid along a trench dug into the base of the existing ledge. The trench will be filled with drainrock to surround the pipe. A layer of filter-cloth will then be laid over the trench to protect the drainrock. As the backfill material is placed in layers, at the contact area between the fill and the sandstone ledge, a layer of drainrock will be placed at the interface in all areas subject to seepage flow coming down the ledge. As each successive layer of backfill is installed, the drainrock interface layer will be installed as well. Therefore, as the backfill layers build up from bottom to top, a drainrock layer between the fill and the ledge rock will be built up as well. This will form a permanent conduit for the seepage water to follow from the ledge down to the collection drainpipe. The collection pipe will extend beyond the extent of the fill and will discharge into the same culvert under the Forest Service Road as does the primary discharge flow fro the reclaimed portals described in item 4 above. Refer to Drawing 5-15 for a schematic of the Old Loadout Area ledgerock seep collection system.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil as indicated by laboratory results of the most needful increment.

The areas to be topsoiled will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

14. Revegetation - Old Loadout Area

Revegetation procedures for the Old Loadout Area involves a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

15. Reclaim Forest Service Road North of Expansion Area

The Forest Service/Emery County road from the trailhead/turnaround will be reclaimed according to the Special Use Permit. As stipulated in the existing Forest Service special use permit (8/26/89) covering the road, during final reclamation the width of the asphalt road surface within the permit area will be reduced from a 27 foot subgrade and 22 foot running surface to a 20 foot subgrade and 14 foot running surface. Asphalt removed from the permit area as part of this road narrowing will be taken to a approved RCRA disposal site. The reclaimed area will be topsoiled and revegetated as described above.

Based on recent correspondence, the Forest Service now indicates that it prefers to have the asphalt totally removed from the road surface upon final reclamation. This position differs from the stipulations of the existing Forest Service Special Use Permit that requires that a 14' asphalt running surface be left in place upon final reclamation. Genwal commits to reclaiming the road through the minesite to any standard desired by the Forest Service/Emery County at the time of final reclamation. At the present time, however, it is difficult for Genwal to commit to a reclamation standard for the road that is contrary to the existing Forest Service Special Use Permit. Since the road now provides permanent access to the Crandall Canyon Memorial, which is owned by Emery County, the final disposition of the reclamation requirements regarding pavement removal may be determined in the future depending on discussions between the agencies involved.

16. Demolition and Removal of Surface Facilities - Expansion Area

The facilities to be removed from the Expansion Area are: the overhead conveyor, stacking tube, reclaim vault and tunnel/escapeway tube, crusher building, MCC building, loadout conveyor, truck loadout and loading platform. Removal of these facilities will take place simultaneously with removal of facilities from the aforementioned areas. After these surface facilities are removed, the only structures that will remain will be the sedimentation pond and associated spillway and discharge structure as well as the conveyance ditches, berms and culverts necessary to route drainage to the pond. Refer to Plates 5-16 and 7-5 for location of these

structures.

Equipment used in the demolition and disposal of the facilities include: a front end loader, a backhoe, highway end dump trucks, a trackhoe, a crane, truck with flat bed trailer, oxy-acetylene torches, air compressor and power tools, etc.

17. Removal of Fill Material and Recontouring - Expansion Area

Reclamation of the Expansion Area (which includes the south portal access ramp) is different from the other reclaimed areas because restoration of the approximate original contour involves removal of fill material rather than placement of backfill material. As described in the preceding sections, fill material removed from the Expansion Area will be used to regrade and restore approximate original contour at the Portal Area, Old Substation Area, Shop Area, and the Old Loadout Area. Therefore, these reclamation operations will be accomplished simultaneously. Expansion Area fill that is not slated for use as backfill for the aforementioned areas (i.e. excess fill) will be disposed of in an approved off-site land fill.

Reclamation of the Expansion Area involves three separate procedures involving three separate areas: the North Slope of the Expansion Area, the Crandall Creek Channel Area, and the South Slope of the Expansion Area. As described previously, the North Slope Expansion Area is that area north of the existing Crandall Creek and south of the existing Forest Service road. The South Slope Expansion Area includes the steeper hillside located south of the existing Crandall Creek and the south portal area. The Crandall Creek Channel Area is the area within and immediately on either side of the existing creek channel.

Reclamation of the North Slope Expansion Area will follow the normal reclamation procedures described above for the other general areas (i.e. regrading, topsoiling and revegetation). Reclamation on the steeper than normal slopes of the South Slope Expansion Area will involve a different reclamation technique which is designed to revitalize the existing left-in-place topsoil. Reclamation of the Crandall Creek Channel Area is also designed to revitalize the existing left-in-place topsoil and restore the previous channel morphology.

As a result of the Crandall Canyon Mine disaster of August 6, 2007, Genwal deeded a portion of the upper mine yard (Expansion Area) to Emery County to be used as part of a permanent memorial to the deceased miners. (Refer to Appendix 5-27 for details of the deed agreement.) This deeded area measures approximately 150' x 235' (0.0803 acres) and now serves as the parking lot for the memorial, as well as the beginning portion of the trail that leads to the memorial headstones, as shown on Plate 5-3. As well as deeding this area to the County, the company also conveyed to the County a permanent easement for a road through the privately-owned part of the minesite. This road is a continuation of the existing Forest Service road, and will provide permanent public access to the memorial, even after final reclamation of the minesite. Since the parking lot is now owned by Emery County as part of the memorial, the upper end of the Expansion Area, including the initial (upper) 156' segment of bypass culvert running underneath it, will be left in place permanently. Other than leaving this upper area in

place, all other elements of reclamation of the Expansion Area, as described herein remain the same.

18. Restoration of South and North Hillside Slopes - Expansion Area

Five years prior to beginning reclamation operations, Genwal will consult with the Division to re-evaluate the techniques and practices being proposed for the Expansion Area. 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.

At the time of final reclamation, all surface facilities located on the Expansion Area pad will be dissassembled and removed from the site. In the area of the (then removed) coal stockpile, all coal will be removed from the small adjacent slope area where the south flank of the coal pile had previously rested. Prior to reclaiming this area, all coal fines will be vacuumed from the surface. Using the existing pad as a work surface, a 12" layer of topsoil will then be reapplied to the disturbed area. Areas to receive topsoil will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil, prior to seeding, if a need is indicated by laboratory results. The fertilizer will be spread on the redistributed topsoil and hand-raked into the soil.

Revegetation procedures for this area will involve a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation.

Following the surface facility demolition activities, fill material will be removed from the Expansion Area in approximately 5'-10' lifts. During the fill removal process, the culvert inlet structure will be left in place on the west end of the yard to continue the diversion of water

through the 72" culvert. A 40 foot wide berm will be left intact at the culvert inlet to continue to serve as the culvert headwall and to continue to divert water into the 72" culvert.

The sequence for removing the fill material, culvert, and underdrain system from the Expansion Area will be essentially the same as during the 1997 construction process but in reverse order. (See construction details in Appendix 7-50).

Fill will be removed from the Expansion Area in 5'-10' lifts starting from the west end of the yard and proceeding to the east end. At the intersection of the South Slope and the pad fill the marker soil/geotextile fabric will be located. The marker soil will be carefully removed from on top of the geotextile fabric on the South Slope as the yard fill is being removed. This will allow reclamation to be done on vertical increments of the hillside that will be easy to access from the adjacent yard level. Removal of fill material adjacent to the South Slope will be done very carefully in order not to disturb the in-place soil resources. Fill removal in this area will be done with small earth-moving equipment (Bobcats, backhoes, etc.) and/or by hand if necessary in order to minimize disturbance of the topsoil. Once the geotextile fabric has been exposed, the fabric will be carefully peeled away from the soil and the condition of the underlying soil materials observed at this time. The soil will be reclaimed and revegetated in 5-10 foot horizontal zones that can be easily accessed and worked by hand from the adjacent pad fill level. After each level has been reclaimed as described below, another lift (5-10 feet of fill) will be removed from the fill. Revegetation work will continue on the next increment of hillside below the previously reclaimed level. This work will be done in continued successive lifts, involving fill removal, peeling away the geotextile, revitalization of the in-place topsoil, and revegetation of the newly exposed increment.

It should be noted that approximate original contour of the North Slope of the Expansion Area will also be re-established as the Expansion Area fill is being removed in lifts as described previously. As the fill is being removed in vertical lifts, the adjacent North Slope surface will be regraded and prepared for subsequent topsoil application.

Sediment control during fill excavation will be met by continued use of the sediment pond east and downstream from the yard area. The main 72" culvert inlet and an adequate amount of fill to maintain the existing headwall will be left intact during this phase of the fill retrieval process.

19. Revegetation - South Slope of the Expansion Area

Reclamation of the South Slope will take place in vertical increments (lifts) simultaneously with the removal of the fill material in corresponding lifts. As fill lifts are being removed, the adjacent newly exposed hillside will be reclaimed and revegetated.

It is anticipated that after the Expansion Area fill is removed in lifts and the geotextile fabric is peeled away in vertical increments, the underlying soil material could be somewhat compacted. To enhance the ability of the soil to absorb moisture, a mixture of PAM

(Polyacrylamide) or best technology currently available at the time of reclamation, will be applied to the soil surface. PAM is designed to relieve compaction of the soil and open up channels for air and water penetration. This treatment will be applied in successive 5-10' lifts as the fill is removed and the hillside is exposed.

The re-exposed soil structure will most likely be undamaged but lacking in microbes and nutrients. In order to regenerate naturally existing soil organisms and assist in reactivating soil activity, an inoculum will be applied to the soil to reestablish soil bacteria, microhorizia and mycelium. To enhance soil microbial establishment and promote more rapid stabilization of the soil the non-riparian seed mixture (as listed in Appendix 3-6) will be hand broadcast over the area and raked into the soil surface. A wood fiber mulch will be applied over the seed bed then the surface will be sprayed with a bonded fiber matrix tackifier. This type of tackifier has appeared to have a much greater ability than regular tackifier to hold and stabilize the soil surface. The bonded fiber matrix tackifier will be applied at a rate of 3,500 pounds per acre (or manufacturer's recommended application if greater).

By removing the fill in 5'-10' lifts and simultaneously reclaiming the adjacent South Slope in corresponding lifts, the pad area can then serve as convenient operating platform for the machinery and supplies used during the reclamation effort. In this manner heavy machinery will not be required to maneuver on the steep slopes. All reclamation work performed directly on the steep slopes will be done with hand labor and tools. The reclamation process will be supported by heavy equipment staged on the adjacent pad level.

20. Removal and Disposal of 72" Culvert

During the 1997 construction of the expanded surface facilities, the creek channel configuration was left intact throughout the entire length of the Expansion Area. This was accomplished by covered the channel in situ with a geotextile fabric during initial construction period. The geotextile was placed over the channel to preserve the indigenous soil and morphology of the existing creek bed. The fabric was placed along the bottom and 5 feet above the channel embankment. A colored marker material was placed on top of the geotextile to serve as a visual marker horizon during reclamation operations.

Fill removal (and South Slope reclamation) will proceed vertical lifts until the 72" culvert has been exposed. Prior to removing the culvert, the stream flow will be diverted into the 18" underdrain system by removing the cap from the drain pipe located at the upstream end of the culvert. This will be done during a low flow period of the year, such as July or August. Once the streamflow has been successfully diverted into the underdrain system, removal of the 72" culvert can begin. Removal of the culvert will be done in 20' segments starting from the upstream end and working downstream. All culvert material will be removed from the site and disposed of in an approved landfill. The remaining culvert bedding material (2" x 0" gravel), which is located on top of the underdrain system, will be left in place at this time to provide a stable work area for heavy equipment involved in subsequent reclamation of the North Slope as described later in this discussion.

Starting at a point immediately below the Emery County Memorial parking facility, the 72" culvert will be removed downstream to an elevation just above the sediment pond. At this time, a new culvert inlet and headwall will be re-established for the remaining 72" culvert segment. The headwall will be rebuilt at this location according to original headwall design and will be rip rapped in a similar manner. At this stage of the reclamation process, approximately 944' of 72" culvert will have been removed and approximately 400' still remains inplace below and around the left-in-place sediment pond. However, stream flow will still continue to flow temporarily through the underdrain system at this time until the North Slope reclamation has been completed.

As the 72' culvert is being removed in the area immediately above the sediment pond, the mine water discharge structure (armored channel) will be brought down from the existing culvert under the Forest Service Road to the restored creek. Temporary piping from the road to the 72" culvert will be used at all time to insure that the discharge water is always contained and is not allowed to run across the fill as it is being excavated.

21. Topsoiling - North Slope of the Expansion Area

After the Expansion Area fill and the 72" culvert have been removed, the underdrain system will still remain intact. Because this phase of work will be done during low flow, the stream will be adequately carried through the underdrain system. Mobile earthmoving equipment will still be able to operate on top of the 2" x 0" bedding material located over the underdrain system. Reclamation of the North Slope, which is not as steep as the south slope, will be done with the standard protocol for reclamation involving topsoiling and revegetation.

Topsoil will be reapplied to the North Slope in the conventional manner. Topsoil will be hauled in by truck and spread with a front end loader and/or backhoe. Areas to receive topsoil will be marked with stakes indicating the depth of application. A reclamation supervisor will oversee the topsoil redistribution operation. Topsoil will be left in a roughened condition prior to seeding to minimize compaction and erosion as well as promote infiltration of precipitation.

Genwal has committed to adding nutrients as determined by laboratory analysis conducted on topsoil samples taken before topsoil redistribution and during final reclamation. The method used to ensure adequate and representative samples from different locations and depths within the topsoil stockpile include: taking two soil samples per stockpile and collecting samples with a soil auger at two foot increments. Samples of the undisturbed soil adjacent to the regraded site will also be taken for a baseline chemical reference. Fertilizer will be added to the redistributed topsoil as indicated by laboratory results.

22. Revegetation - North Slope of the Expansion Area

Revegetation procedures for the North Slope of the Expansion Area involves a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3)

hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

23. Restoration of the Stream Channel

After the north slope has been topsoiled, the underdrain system will then be removed and the stream channel morphology restored. Prior to removal of the underdrain, silt fences will be established in Crandall Creek downstream from the existing 72" culvert outlet. These silt fences will be located in an area convenient for maintenance and cleanout.

Removal of the underdrain system will be done during low flow conditions and will be completed in reverse order from the way it was originally installed. Using small mobile equipment, such as a backhoe, the remaining culvert bedding material, drain rock and 18" drain pipe will be removed in 20' segments starting from the upper end and working downstream. After the drain rock and drain pipe are removed, the lower layer of geotextile can be carefully peeled back, re-establishing the "natural" streambed in the process. All drain rock, drain pipe and geotextile material removed during this process will be disposed of at an approved landfill. As each 20' segment of the underdrain system is removed, silt fencing will be installed on either side of the newly restored stream channel. The purpose of this silt fencing is to treat drainage from the adjacent recently reclaimed areas.

After the underdrain system has been removed and the stream channel re-established downstream past UD-1, a rip rapped ditchway will be installed to carry drainage from the side culvert outlet down the North Slope to the restored stream channel. Refer to Plate 5-16.

The underdrain system will be removed downstream to an elevation just above the sediment pond at the location of the new 72" culvert inlet and headwall. At this time, the remaining 18" drain pipe will be recapped and the stream flow rediverted back into the 72" culvert. [Note: this new sediment pond/culvert/underdrain configuration will remain in place until Phase 2 reclamation, as described later]. At this stage of the reclamation process, approximately 944' of 72" culvert and underdrain system will have been removed and approximately 400' will still remain inplace to divert channel flow below and around the left-in-place sediment pond.

As the stream channel is being restored in the area immediately above the sediment pond, the mine water discharge structure (armored channel) will be brought down from the existing culvert under the Forest Service Road to the restored creek.

24. Revegetation of the Stream Channel

It is anticipated that after the underdrain system is removed and the geotextile fabric is peeled away, the underlying soil material along the stream banks will be somewhat compacted. To enhance the ability of the soil to absorb moisture, a mixture of PAM (Polyacrylamide) or best technology currently available at the time of reclamation, will be applied to the soil surface. PAM is designed to relieve compaction of the soil and open up channels for air and water penetration.

The re-exposed soil structure will most likely be undamaged but lacking in microbes and nutrients. In order to regenerate naturally existing soil organisms and assist in reactivating soil activity, an inoculum will be applied to the soil to reestablish soil bacteria, microhorizia and mycelium. To enhance soil microbial establishment and promote more rapid stabilization of the soil, the riparian seed mixture (as listed in Appendix 3-6) will be hand broadcast over the area and raked into the soil surface. A wood fiber mulch will be applied over the seed bed then the surface will be sprayed with a bonded fiber matrix tackifier. This type of tackifier has appeared to have a much greater ability than regular tackifier to hold and stabilize the soil surface. The bonded fiber matrix tackifier will be applied at a rate of 3,500 pounds per acre (or manufacturer's recommended application if greater).

25. Sediment Control and Treatment

In practice, many of the reclamation procedures outlined above will be conducted simultaneously. However, the sediment pond will provide complete sediment control during all phases of the reclamation process until such time as the upper 1,100' segment of 72" culvert has been removed and removal of the underdrain system begins. Sediment control during removal of the underdrain will consist of silt fences constructed on either side of the newly restored stream channel and silt fences constructed within Crandall Creek below the outlet of the 72" culvert.

26. Topsoil Stockpile Location Reclamation

Following the removal of the topsoil stockpiles from the storage sites (during final reclamation retopsoiling activities), the topsoil pile locations will be reclaimed. (Enough topsoil will remain stockpiled for Phase 2 reclamation. Refer to the Phase 2 reclamation discussion in item #27 below.) The topsoil stockpile locations will not require soil redistribution since the native topsoil is still in place. At these locations, the ground will be lightly scarified and then reclaimed according to the standard reclamation protocol.

Revegetation procedures for the stockpile locations will involve a four step program: 1) application of fertilizer (if laboratory testing indicates a need), 2) hydroseed, 3) hydromulch the entire area with a wood fiber mulch to stabilize soil during vegetative growth and control runoff, 4) plant containerized stock to further stabilize the soil and provide vegetative diversity. Hydroseeding will combine the tackifier and small amount of mulch with the seed mix (to mark

the area of coverage) during application to the redistributed topsoil. All seed utilized on the site will be certified pure live seed. After the seeding step, the mulch (wood fiber and hay/straw) and tackifier will be applied to the seedbed surface. The plant containerized stock will be planted in the second year of reclamation. Revegetation work will not be done until fall (September-October).

Phase 2

27. Phase 2 Reclamation - Removal of Sedimentation Pond

During Phase 2 reclamation, prior to any earthwork activity, silt fences will be installed across the entire length of the downstream at the east end of the sediment pond embankment to filter any sediment resulting from removal of the pond. Additional silt fences will be installed in Crandall Creek below the culvert outlet to provide additional sediment control.

Removal of the sediment pond and the remaining 72" culvert/underdrain system will follow the same procedures described previously for the removal of the expansion area fill. The pond embankment will be removed in lifts down to the 72" pipe. Reclamation (grading, topsoiling and revegetation) of the North and South Slopes will be done in the same manner as described for the Expansion Area in Phase 1 reclamation. After the 72" culvert has been exposed the end cap will be removed from the 18" drain pipe located in the underdrain system. Flow will then be diverted through the underdrain system in the drain rock below the 72" pipe. The 72" pipe will be completely removed at this time.

After the 72" pipe has been completely removed, the geotextile fabric will be removed from the top of the underdrain system. The drain rock and 18" drain pipe will be removed with a small backhoe and hauled off-site for disposal. The drain rock beneath the drain pipe will be shoveled out of the channel and the geotextile that was placed over the original channel will be removed by hand, restoring the original stream channel morphology. The disturbed area will be revegetated in the manner previously described for the previously reclaimed areas. In many ways Phase 2 reclamation of the sediment pond embankment will be nearly identical to the Expansion Area reclamation described previously for Phase 1. Both areas involve the steeper South Slope, the stream channel culvert/underdrain system, and the less steep North Slope. Therefore, all pertinent aspects of reclamation which apply to Phase 1 as described in this appendix will also apply to Phase 2. This includes the special steep-slope reclamation techniques for the South Slope, the left-in-place soil revitalization for the channel area, and the standard reclamation procedures for the North Slope.

APPENDIX 5-27

CRANDALL CANYON MINE MEMORIAL
EMERY COUNTY
MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF AGREEMENT

by and between

INTERMOUNTAIN POWER AGENCY,

ANDALEX RESOURCES, INC. and

EMERY COUNTY, UTAH

THIS MEMORANDUM OF AGREEMENT ("**Agreement**") is entered into this 21 day of May, 2008 (the "**Effective Date**") by and between **INTERMOUNTAIN POWER AGENCY,** a political subdivision of the State of Utah ("**IPA**"); **ANDALEX RESOURCES, INC.,** a Delaware corporation ("**ANDALEX**"); and **EMERY COUNTY, UTAH,** a body corporate and politic, acting through the **COMMISSION OF EMERY COUNTY, UTAH** ("**Emery County**"). Concerning IPA's obligations under this Agreement, the Los Angeles Department of Water and Power, as Operating Agent for the IPA, shall administer this Agreement on behalf of IPA.

WHEREAS, IPA and ANDALEX jointly own certain properties for the production, mining, and loading of coal at or near the town of Huntington in Emery County, Utah known as the Crandall Canyon Mine;

WHEREAS, on or about August 6, 2007, an accident occurred at the Crandall Canyon Mine resulting in six miners being trapped in the Mine;

WHEREAS, the six trapped miners, Kerry Allred, Don Erickson, Luis Hernandez, Juan Carlos Payan, Brandon Phillips and Manuel Sanchez, are now deceased;

WHEREAS, the families of the six trapped miners have now expressed their desire to establish a monument at the site of the Crandall Canyon Mine as a permanent memorial;

WHEREAS, on February 19, 2008, Emery County unanimously voted to support and represent the families of the six trapped miners in their efforts to establish the permanent memorial;

WHEREAS, ANDALEX and IPA fully support the families' efforts to establish a permanent memorial to the six trapped miners; and

WHEREAS, ANDALEX, IPA and Emery County now desire to enter into this Memorandum of Agreement for the purpose of setting forth their agreement and understanding concerning the establishment of a permanent memorial to the six miners trapped in the Crandall Canyon Mine and will endeavor to complete the memorial by August 6, 2008.

NOW THEREFORE, for and in consideration of the above premises and in consideration of the mutual benefits to be derived, the parties agree as follows:

1. ANDALEX, IPA and Emery County mutually agree to cooperate for the purpose of establishing a monument at the site of the Crandall Canyon Mine as a permanent memorial to the six miners trapped in the Crandall Canyon Mine on August 6, 2007. The memorial shall be hereinafter referred to as the "**Crandall Canyon Memorial.**" The location map and site plan for the Crandall Canyon Memorial, including an associated trail and parking lot, to be established at the site of the Crandall Canyon Mine are attached hereto as Exhibit 1.

2. As shown on Exhibit 1, the Crandall Canyon Memorial shall be located on land owned by the United States Forest Service ("**USFS**"). The dedicated parking lot for the Crandall Canyon Memorial will be located on fee land jointly owned by ANDALEX and IPA. The trail leading from the parking lot to the site of the Crandall Canyon Memorial will be located partially on land owned by USFS, and partially on land owned by ANDALEX and IPA. It is the intent of the parties hereto that Emery County will own all permits, rights-of-way, and real property necessary for the establishment, construction, and maintenance of the Crandall Canyon Memorial and associated facilities, including the parking lot and trail.

3. Emery County shall prepare and submit an application to the USFS for a Special Use Permit for the Crandall Canyon Memorial site and trail. ANDALEX and IPA agree to assume joint responsibility for the costs associated with the preparation of the application for the Special Use Permit. In addition, if the USFS determines that analysis is required under the National Environmental Policy Act ("**NEPA**") for federal actions associated with the Crandall Canyon Monument, ANDALEX and IPA agree to assume joint responsibility for the costs associated with the preparation of any such analysis.

4. ANDALEX and IPA will convey by quit claim deed to Emery County the real property (located near the upper section of the mine material storage yard) to be dedicated to the memorial parking lot and the beginning section of the trail (**"Deeded Land"**), on land located in Emery County, Utah, and more particularly described as follows:

   Beginning at the Northwest Corner of the Southwest Corner of Section 5, Township 16 South, Range 7 East of the Salt Lake Baseline and Meridian; thence running N88°06'35"E for 235.13'; thence South for 152.75'; thence West for 235.00'; thence North along the west section line of Section 5 for 145.00' to the Point of Beginning, containing 0.803 acres, more or less.

5. ANDALEX and IPA will also grant to Emery County an easement ("**Road Easement**") for a public road through the minesite which will connect the Deeded Land to the existing Forest Service Road No. 50248 (a.k.a., Crandall Canyon Road), on land located in Emery County, Utah, and more particularly described as follows:

   Encompassing 22.0' on either side (44' total) of a center line

beginning at a point that is located N88°06'35"E 695.40' from the Northwest Corner of the Southwest Corner of Section 5, Township 16 South, Range 7 East of the Salt Lake Baseline and Meridian; thence running S59°33'11"W for 12.78'; thence S54°25'37"W for 50.0'; thence S56°02'53"W for 50.0'; thence S65°54'48" W for 50.0'; thence S80°43'13"W for 50.0'; thence N84°43'48" for 50.0'; thence N62°43'15"W for 50.0'; thence N70°56'20"W for 50.0'; thence N73°32'52"W for 48.36'; thence S88°06'35"W for 319.18' to the end point which is located 22.0' South of the Northwest Corner of the Southwest Corner of said Section 5.

This easement follows the alignment of the existing public access through the minesite to the Forest Service trailhead. The ANDALEX operator, Genwal Resources, Inc. (**"GRI"**) will continue to be responsible for all maintenance of this road until such time as the mine is reclaimed as provided in the MRP as that term is defined in paragraph 6 below and Phase 1 bond release is obtained. At the time of final reclamation GRI will reclaim this segment of road to the extent required by State and Federal regulations.

6. The parties acknowledge that the Deeded Land is currently included within the Crandall Canyon Mine Mining and Reclamation Plan, Permit No. C015/032 (**"MRP"**) filed with the Utah Division of Oil, Gas and Mining (**"DOGM"**). ANDALEX through GRI, as permittee, shall amend the MRP to acknowledge the memorial parking area and trailhead within the Deeded Land as permanent structures and will obtain a post-mining land use change in the MRP to reflect this change. GRI will remove those portions of the Deeded Land used in conjunction with the memorial from all MRP permitting and reclamation requirements.

7. Within the Deeded Land a fence and/or barrier shall be constructed by GRI to delineate and separate the boundary of the memorial parking area from the mine operational area, at the approximate location and configuration as shown on Exhibit 1 attached hereto. The parties acknowledge that the mine operation area outside the parking area delineation can continue to be used by GRI for mine-related operations and reclamation until the mine is reclaimed as provided in paragraphs 8, 9 and 10 herein, and is further subject to the terms of that certain Right-of-Way Easement effective as of January 1, 2004, by and between ANDALEX, IPA and PacifiCorp (**"PacifiCorp ROW"**). The quit claim deed conveying the Deeded Land to Emery County will expressly except and reserve these uses.

8. GRI shall continue to be responsible for all MRP permitting and reclamation obligations for the operational area of the Deeded Land located outside the delineated memorial area and for the road easement. Emery County will assume no permitting or reclamation liabilities under the MRP for the Deeded Land or the Road Easement and GRI agrees to indemnify and hold harmless Emery County from all costs, penalties and liabilities associated with its permitting and reclamation obligations under the MRP.

9. A 6-foot diameter undisturbed drainage culvert is presently located under the Deeded Land, and will not be removed as a result of post-mining reclamation. GRI will amend

the MRP permit to acknowledge that within the Deeded Land, the memorial parking area and trail and the underlying culvert will remain as permanent structures as a post-mining land use, as shown on Exhibit 2 attached hereto. GRI will be responsible for all maintenance and upkeep of this segment of culvert until such time as the mine site is reclaimed and Phase 1 bond release is achieved under the MRP. Prior to Phase 1 bond release, GRI will make any and all necessary repairs to the culvert so that it is deemed at that time by Emery County to be fully functional. Following Phase 1 bond release, Emery County will assume responsibility for maintenance of the culvert and will indemnify and hold GRI harmless from all costs and liabilities associated with the culvert.

10. Emery County acknowledges that a small area within the northeast corner of the Deeded Land (as shown on Exhibit 1) is now, and has been in the past, used as an integral part of the existing Forest Service trailhead and trailhead parking facility, open to the public, and agrees that this unrestricted usage will continue in the future, at the discretion of the Forest Service, both while the mine remains in operation and after reclamation is completed in accordance with the MRP and Forest Service Special Use Permit PRI42.

11. ANDALEX and IPA agree to assume joint responsibility for costs associated with the construction of the Crandall Canyon Memorial, trail, parking lot, and parking lot delineation. Further, ANDALEX and IPA agree to oversee the construction of the Crandall Canyon Memorial project and to secure all necessary construction contracts related thereto. The trail leading to the Crandall Canyon Memorial shall be designed and constructed to meet applicable Emery County and USFS standards, if any.

12. Following execution of this Memorandum of Agreement, ANDALEX and IPA will promptly initiate discussions with USFS to effect a land exchange with USFS whereby: (i) ANDALEX and IPA would acquire from USFS joint ownership of a yet to be defined parcel of USFS land surrounding the site of the Crandall Canyon Memorial and located adjacent to the Deeded Land, and (ii) in exchange, USFS would acquire ownership of a yet to be defined parcel of real property owned by ANDALEX and IPA and located in lower Huntington Canyon, as shown on Exhibit 3 attached hereto. It is anticipated that USFS will issue the Special Use Permit discussed in Paragraph 3 above to Emery County for renewable five (5) year terms with the understanding that the surface area situated around the site of the Crandall Canyon Memorial will ultimately be conveyed by USFS to ANDALEX and IPA in a land exchange. The parties hereto will use their best efforts to diligently pursue the exchange with the USFS. Once the land associated with the Crandall Canyon Memorial has been acquired by ANDALEX and IPA through the exchange from USFS, it will be conveyed to Emery County to ensure that Emery County can maintain full administrative control of the Crandall Canyon Memorial without the long-term involvement of USFS.

13. ANDALEX and IPA agree to assume joint responsibility for the costs associated with reasonably necessary title searches and abstracts for the property to be transferred to Emery County by the terms of this Agreement. However, ANDALEX and IPA will not warrant title to such property.

14. It is the intent of ANDALEX, IPA and Emery County that, subject to Paragraphs 8, 9 and 10 above, following the construction of the Crandall Canyon Memorial, issuance of the necessary permits and the transfer of real property as described herein, Emery County shall assume permanent responsibility for maintenance and upkeep of the Crandall Canyon Memorial, trail, parking lot and any other properties or structures associated therewith. Following such time, and subject to paragraphs 8, 9 and 10, Emery County shall indemnify and hold harmless ANDALEX, IPA and GRI from all costs and liabilities associated therewith.

15. This Memorandum of Agreement shall take effect on the Effective Date and shall terminate upon the first to occur of the following events:

(a) ANDALEX, IPA and Emery County have satisfied their respective obligations hereunder; or

(b) Ten (10) years following the Effective Date.

16. This Memorandum of Agreement may not be assigned by any party hereto, without the prior written consent of the other parties hereto. The provisions of this Memorandum of Agreement are binding on, and shall inure to the benefit of the parties hereto and their permitted successors and assigns.

17. All notices, requests, demands and other communications required or permitted under this Memorandum of Agreement shall be in writing and shall be deemed to have been given on the date of delivery in person or of deposit in the United States mail, postage prepaid, if sent by registered or certified mail, return receipt requested, addressed to the parties at the addresses set forth below, or at such other addresses as to which the parties give notice in accordance herewith.

If to IPA:
Intermountain Power Agency
c/o Los Angeles Department of Water and Power
111 North Hope Street, Room 1263
Los Angeles, California 90012
Attention: William Engels
Facsimile: (213) 367-0269

If to ANDALEX:
ANDALEX Resources, Inc.
6750 N Airport Rd
P.O. Box 902
Price, UT 84501
Attention: David Shaver
Facsimile: (435) 888- 4002

If to Emery County:
Emery County Commission
Emery County Courthouse
Castle Dale, UT 84513
Attention: Ray D. Petersen
Facsimile: (435) 381-5644

18. No waiver of any of the provisions of this Memorandum of Agreement shall be deemed or shall constitute a waiver of any other provision hereof.

19. Nothing in this Memorandum of Agreement shall entitle any person or entity other than the parties hereto, their successors and assigns, to any claim, cause of action, remedy or right of any kind.

20. This Memorandum of Agreement may be executed in any number of counterparts and each such counterpart hereof shall be deemed to be an original instrument, but all such counterparts together shall constitute for all purposes one document.

21. This Memorandum of Agreement constitutes all of the promises and agreements between the parties hereto with respect to the subject matter of this Agreement and supersedes any and all prior understandings, inducements or conditions, either expressed or implied, oral or written

IN WITNESS WHEREOF, the parties have executed this Memorandum of Agreement as of the date first shown above.

INTERMOUNTAIN POWER AGENCY

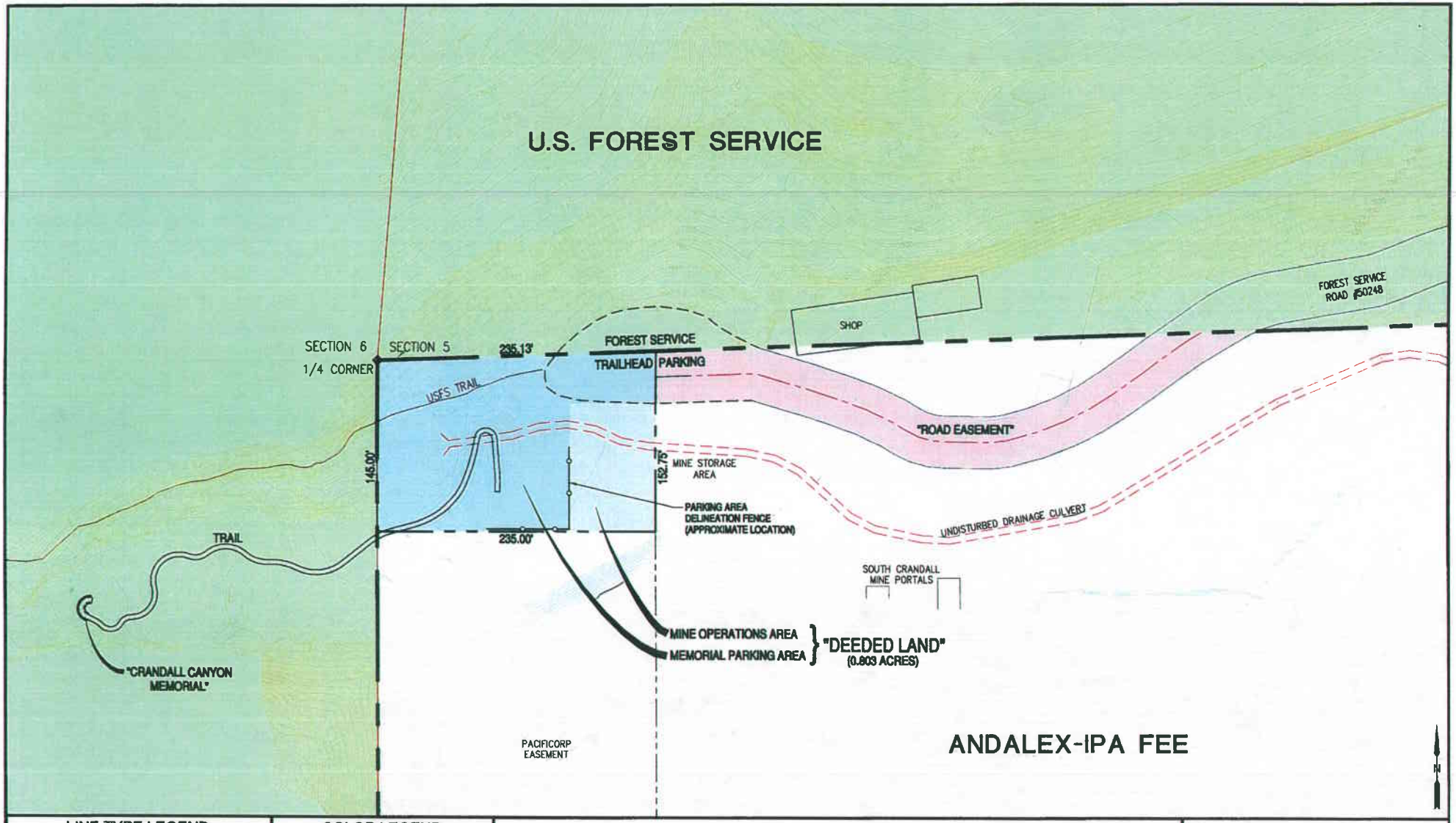
By: _____
Name: James A. Hewlett
Title: General Manager

ANDALEX RESOURCES, INC.

By: P. Bruce Hill
Name: P. Bruce Hill
Title: President & CEO

EMERY COUNTY, UTAH, a body corporate and politic, acting through the **COMMISSION OF EMERY COUNTY, UTAH**

By: Drew Sitterud
Name: Drew Sitterud
Title: Commission, Chair


U.S. FOREST SERVICE
SECTION 6
1/4 CORNER
SECTION 5
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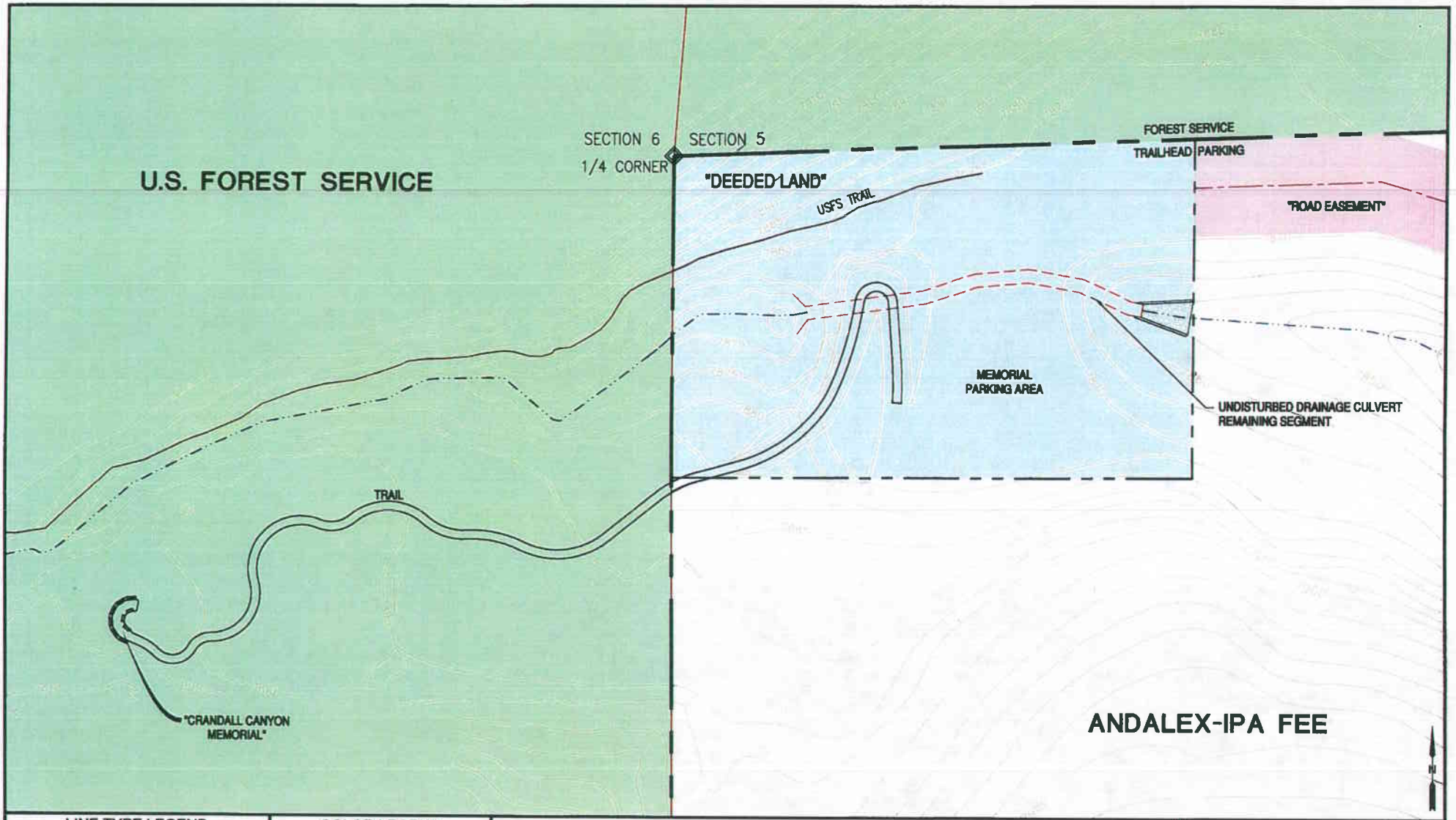
FOREST SERVICE
TRAILHEAD PARKING
SHOP
FOREST SERVICE
ROAD #50248
USFS TRAIL
"ROAD EASEMENT"
145.00'
152.75'
MINE STORAGE
AREA
PARKING AREA
DELINEATION FENCE
(APPROXIMATE LOCATION)
UNDISTURBED DRAINAGE CULVERT
235.00'
TRAIL
SOUTH CRANDALL
MINE PORTALS
MINE OPERATIONS AREA
MEMORIAL PARKING AREA
"DEEDED LAND"
(0.903 ACRES)
"CRANDALL CANYON
MEMORIAL"
PACIFICORP
EASEMENT
ANDALEX-IPA FEE
N
LINE TYPE LEGEND
SECTION LINE
LAND OWNERSHIP / CONTROL BOUNDARY
EXISTING CONTOUR LINES AT 5' INTERVALS
EXISTING CONTOUR LINES AT 1' INTERVALS
COLOR LEGEND
MEMORIAL PARKING AREA WITHIN "DEEDED LAND"
MINE OPERATIONS AREA WITHIN "DEEDED LAND"
"ROAD EASEMENT"
U.S. FOREST SERVICE LAND
50' 0 100' 200'
EXHIBIT 1
CRANDALL CANYON MEMORIAL
SITE PLAN



LINE TYPE LEGEND	COLOR LEGEND
SECTION LINE	"DEEDED LAND"
LAND OWNERSHIP / CONTROL BOUNDARY	"ROAD EASEMENT"
RECLAIMED CONTOUR LINES AT 5' INTERVALS	U.S. FOREST SERVICE LAND

20' 0 40' 80'

EXHIBIT 2

POST-MINING RECLAMATION

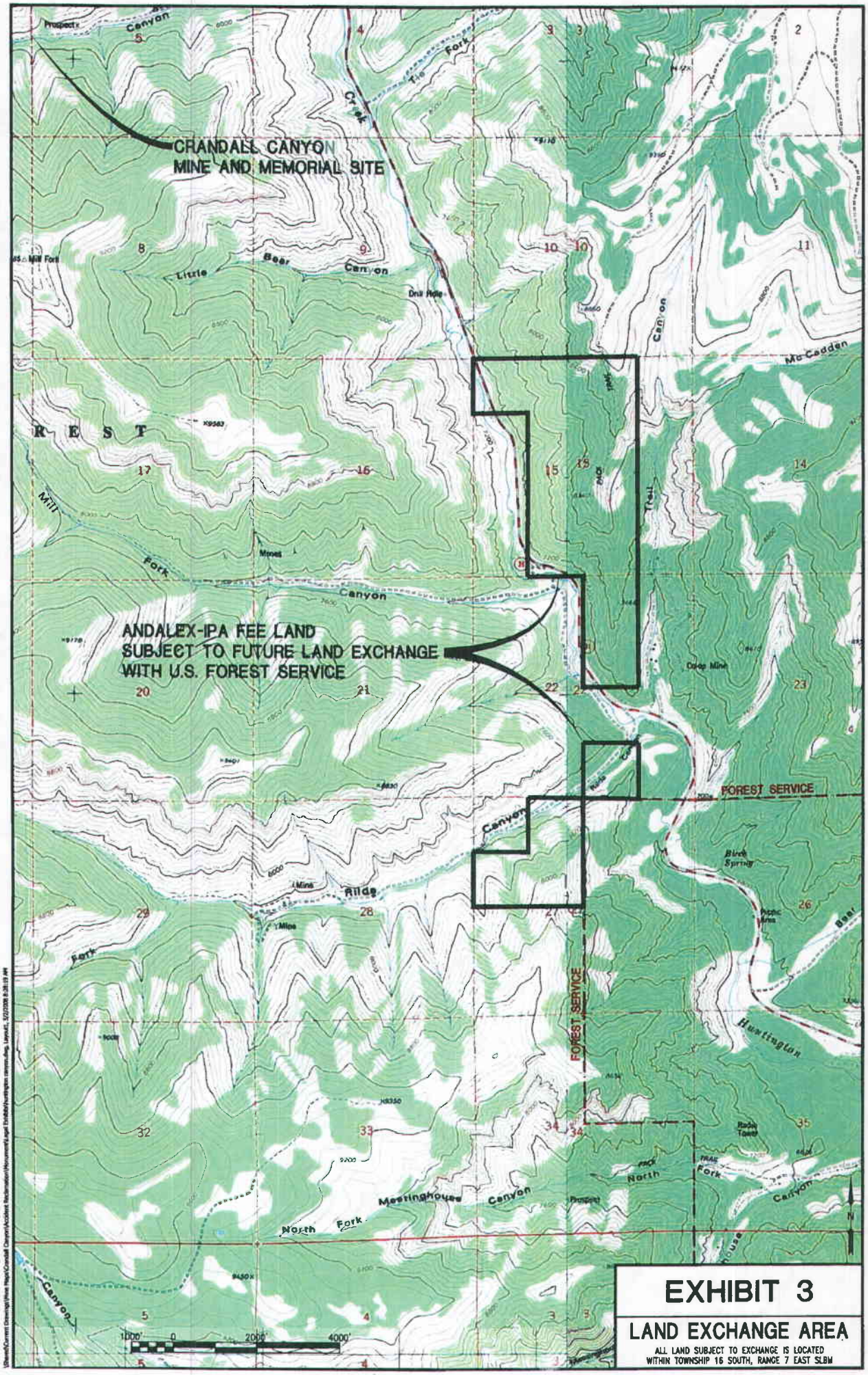


EXHIBIT 3

LAND EXCHANGE AREA

ALL LAND SUBJECT TO EXCHANGE IS LOCATED WITHIN TOWNSHIP 16 SOUTH, RANGE 7 EAST SLBM

WHEN RECORDED, RETURN TO:

David A. Blackwell, Esq.
Emery County Attorney
1850 North 500 West
P.O. Box 249
Castle Dale, Utah 84513

CORRECTED QUITCLAIM DEED

INTERMOUNTAIN POWER AGENCY, a political subdivision of the State of Utah, having an address of 10653 South River Front Parkway, Suite 120, South Jordan, Utah 84095, and ANDALEX RESOURCES, INC., a Delaware corporation, having an address of 6750 North Airport Road, P.O. Box 902, Price, Utah 84501 (collectively "**Grantors**"), hereby quitclaim to EMERY COUNTY, UTAH, a body corporate and politic, having an address of Emery County Courthouse, Castle Dale, Utah 84513, for the sum of Ten Dollars ($10.00), and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the following:

1. Deeded Land. A tract of land identified in Exhibit 1 attached hereto, as the "Deeded Land" located in Emery County, Utah, and more particularly described as follows:

> Beginning at the Northwest Corner of the Southwest Quarter of Section 5, Township 16 South, Range 7 East of the Salt Lake Baseline and Meridian; thence running N88°06'35"E for 235.13'; thence South for 152.75'; thence West for 235.00'; thence North along the west section line of Section 5 for 145.00' to the Point of Beginning, containing 0.803 acres, more or less.

EXCEPTING AND RESERVING UNTO GRANTORS and their agents, affiliates, successors and assigns unlimited access to the area at the approximate location and configuration identified in Exhibit 1 attached hereto as the "mine operations area" for mine-related operations and reclamation until Phase 1 bond release occurs pursuant to the terms of the Crandall Canyon Mine Mining and Reclamation Plan, Permit No. C/015/032, on file with the Utah Division of Oil, Gas and Mining;

AND FURTHER SUBJECT TO the terms of that certain Right-of-Way Easement, effective as of January 1, 2004, by and between Grantors and PacifiCorp, recorded at Entry 368298, Book 315, Page 235, official records of Emery County, Utah.

2. Nonexclusive Road Easement. A nonexclusive easement for a public road identified in Exhibit 1 attached hereto as the "Road Easement" which will connect the Deeded Land to the existing Forest Service Road No. 50248 (a.k.a. "Crandall Canyon Road"), on land located in Emery County, Utah, and more particularly described as follows:

Encompassing 22.0' on either side (44' total) of a center line beginning at a point that is located N88°06'35"E 695.40' from the Northwest Corner of the Southwest Quarter of Section 5, Township 16 South, Range 7 East of the Salt Lake Baseline and Meridian; thence running S59°33'11"W for 12.78'; thence S54°25'37"W for 50.0'; thence S56°02'53"W for 50.0'; thence S65°54'48" W for 50.0'; thence S80°43'13"W for 50.0'; thence N84°43'48" for 50.0'; thence N62°43'15"W for 50.0'; thence N70°56'20"W for 50.0'; thence N73°32'52"W for 48.36'; thence S88°06'35"W for 319.18' to the end point which is located 22.0' South of the Northwest Corner of the Southwest Quarter of said Section 5.

IN WITNESS WHEREOF, Grantors have caused their names to be hereunto affixed this 4TH day of June, 2008.

Grantors:

ANDALEX RESOURCES, INC., a Delaware corporation

By: P Bruce Hill
Name: P. Bruce Hill
Title: Pres & CEO

STATE OF Utah)
: ss.
COUNTY OF Carbon)

The foregoing instrument was acknowledged before me this 4TH day of June, 2008, by Bruce Hill, the President of ANDALEX Resources, Inc.

Notary Public: Linda Kerns

Notary Public
LINDA KERNS
345 N. 700 E.
Price, UT 84501
My Commission Expires
April, 6, 2009
State of Utah

INTERMOUNTAIN POWER AGENCY, a political subdivision of the State of Utah

By: _____
Name: James A. Hewlett
Title: General Manager

STATE OF Utah)
: ss.
COUNTY OF Salt Lake)

The foregoing instrument was acknowledged before me this 21 day of May, 2008, by James A. Hewlett, the general mgr. of Intermountain Power Agency.

Krista R Paull
Notary Public:

KRISTA R. PAULL
NOTARY PUBLIC-STATE OF UTAH
10653 S. RIVER FRONT PKWY #120
SOUTH JORDAN, UT 84095
COMM. EXP. 09-01-2011

INSERT THESE PAGES IN
APPENDIX 7-4

SEDIMENTATION AND DRAINAGE CONTROL
PLAN

APPENDIX 7-4

CRANDALL CANYON MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN

PREPARED BY: *DAN W. GUY, P.E.*
BLACKHAWK ENGINEERING
1056 WEST 2060 NORTH
HELPER, UT. 84526

REVISED: *DECEMBER 2008*

CRANDALL CANYON MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN

TABLE OF CONTENTS

Tables:

Figures:

1. *Introduction*

The Sedimentation and Drainage Control Plan for the Crandall Canyon Mine has been designed according to the State of Utah R645- Coal Mining Rules, November 1, 1996. All design criteria and construction will be certified by a Utah Registered Professional Engineer.

This plan has been divided into the following three sections:

1) *Design of Drainage Control Structures for the Proposed Construction*
2) *Design of Sediment Control Structures*
3) *Design of Drainage Control Structures for Reclamation*

The general surface water control plan for this project will consist of the following:

(a) *The proposed pad expansion will necessitate modifications of a number of existing hydrologic structures on the site. In an effort to clarify the new plan, the entire sedimentation and drainage control plan has been re-evaluated for the site and presented in this Appendix.*

(b) *The general plan for the pad expansion is to divert undisturbed drainage from Crandall Canyon above the minesite through a 6' diameter CMP culvert beneath the expansion area and discharge below the disturbed area. As a result of the expansion, existing culverts C-2, C-8, C-10 and Ditch DD-9 will be removed. 2 new ditches (DD-12 & DD-13) and 3 new culverts (Main Canyon, C-11 and C-11A) will be added to provide for drainage control for the expanded facility. The existing sediment pond will also be expanded to contain additional runoff from the expansion area. All other existing drainage controls will remain unchanged. All minesite drainage controls are shown on Plate 7-5 "Drainage Map".*

(c) *The main canyon culvert is sized to safely pass the runoff from a 100 year - 6 hour*

precipitation event. All other undisturbed diversions, disturbed ditches and culverts are sized to safely convey runoff from a 10 year - 24 hour precipitation event. The sediment pond is sized to contain runoff from a 10 year - 24 hour precipitation event, as required.

DESIGN OF DRAINAGE CONTROL STRUCTURES

Design Parameters:

Tables:

Design Parameters:

2.1 Precipitation

The precipitation-frequency values for the area were taken from the existing plan which lists Miller, et.al. (1973) as the sources.

Frequency - Duration	*Precipitation*
10 year-6 hour	*1.55"*
10 year-24 hour	*2.50"*
25 year-6 hour	*1.90"*
100 year-6 hour	*2.40"*
100 year-24 hour	*3.70"*

2.2 Flow

Peak flows, flow depths, areas and velocities were calculated using the computer program "Office of Surface Mining Watershed Model", Storm Version 6.21 by Gary E. McIntosh. All flow is based on the SCS - TR55 Method for Type II storms.

Time of concentration of storm events was calculated for each drainage area using the following formula:

$$t_L = \frac{L^{0.8}\,(S+1)^{0.7}}{1900\,Y^{0.5}}$$

where:

t_C	=	*Time of Concentration (hrs.)*
t_L	=	*Lag Time (hrs.)* $= 0.6\,t_C$
L	=	*Hydraulic Length of Watershed (ft.)*
Y	=	*Average Land Slope (%)*
S	=	$\frac{1000}{CN} - 10$

2.3 Velocity

Flow velocities for each ditch structure were calculated using the Storm computer program with Manning's Formula:

$$V = \frac{1.49}{n} R^{2/3} S^{1/3}$$

where:

V	=	*Velocity (fps)*
R	=	*Hydraulic Radius (ft.)*
S	=	*Slope (ft. per ft.)*
n	=	*Manning's n; Table 3.1, p. 159,*

"Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner & Haan, 1983.

Note: The following Manning's n were used in the calculations:

Structure	*Manning's n*
Culverts (cmp)	*0.020*
Unlined Disturbed Area Ditches	*0.035*

2.4 Drainage Areas

All drainage areas were planimetered directly from Plate 7-5, Drainage Map, and Plate 7-5C, Watershed Boundaries.

2.5 Slopes, Lengths

All slopes and lengths were measured directly from the topography on Plate 7-5,

Drainage Map, and Plate 7-5C, Watershed Boundaries.

2.6 Runoff

Runoff was calculated using the SCS Formula for Type II Storms; using the Storm Version 6.21 computer program:

$$Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S}$$

where:

CN	=	*Runoff Curve Number*
Q	=	*Runoff in inches*
P	=	*Precipitation in inches*
S	=	$\frac{1000}{CN} - 10$

2.7 Runoff Curve Numbers

Two curve numbers were utilized for the undisturbed areas. Average curve numbers for the north facing and south facing slopes were determined from curves presented in Figure 7-3 (Chapter 7), using measured cover densities as reported in Chapter 3 and the northern half of lease area SL 062648, assuming a hydrologic soil group of C. Curve numbers of 60 and 69 were obtained for the north facing and south facing undisturbed areas, respectively, using Chart A for Oak-Aspen and ground cover densities of 45 and 26 for north facing and south facing areas, respectively. The above referenced Figure 7-3 (Chapter 7) is included in this Appendix as Figure 9.

Runoff curve numbers for reclaimed, disturbed and paved areas were selected based on comparison with Table 2.20 (p. 82, Barfield, et al, 1983) and

numbers previously approved in the M.R.P. A conservative number of 75 was used for reclaimed areas within the disturbed boundary. Curve numbers of 90 and 95

were used for all disturbed areas and paved areas, respectively. See Plates 7-5 and 7-5C for referenced areas.

The following is a summary of runoff curve numbers used in these calculations:

Watershed	*Runoff CN*
Undisturbed (North Facing):	*60*
Undisturbed (South Facing):	*69*
Reclaimed:	*75*
Disturbed:	*90*
Paved:	*95*

2.8 Culvert Sizing

Minimum culvert sizing is based on the following Manning's Equation; using the Haestad Methods, Flowmaster I, Version 3.42 computer program:

$$D = \left(\frac{2.16\ Q\ n}{\sqrt{s}}\right)^{0.35}$$

where: D = *Required Diameter (feet)*
Q = *QP = Peak Discharge (cfs)*
n = *Roughness Factor (0.020 for cmp)*
S = *Slope (ft. Per ft.)*

Using the above formula, minimum required culvert sizes were calculated for each applicable area. Culverts were then selected above the required minimum, and these sizes were checked for adequacy against the Culvert Nomograph included as Figure 1 of this report.

2.9 Culverts

As indicated in Section 1, the proposed pad expansion will necessitate modifications of a number of existing hydrologic structures on the site, including culverts. As a result of the expansion, existing culverts C-2, C-8 and C-10 will be removed. Two new culverts (Main Canyon, C-11) were added to provide drainage control for the expanded facility during phase I of the surface expansion. One more (C-11A) will be added during the phase II south portal construction. All other existing culverts on the site will remain unchanged.

Culverts have been sized according to the calculations previously described, and are summarized on the following tables. The culverts are shown on Plate 7-5, Drainage Map.

All undisturbed diversions are labeled with a UD number (i.e. UD-1). Two of these diversions are culverts (UD-1 and UD-3), and are clearly marked on Plate 7-5. Contributing watersheds for undisturbed diversions are labeled with a WSUD number, (i.e. WSUD-1) as shown on Plates 7-5 and 7-5C. All undisturbed diversion culverts will be fitted with trash racks to minimize plugging by rocks or other debris.

The proposed Main Canyon culvert is sized to carry runoff from a 100 year - 6 hour precipitation event for the Crandall Canyon area above the minesite. A 6' diameter C.M.P. culvert is proposed to carry the Crandall Canyon runoff beneath the expanded pad area and discharge below the minesite. Calculations in Table 10 show the proposed 6' diameter culvert to be more than adequate to carry the expected peak flow. The culvert will be equipped with an inlet headwall and trash rack and a properly sized outlet apron and energy dissipator for erosion protection. Runoff characteristics, flow and culvert design are presented in this Appendix.

The remaining undisturbed culverts on the site (UD-1 and UD-3) are existing. These culverts have been evaluated for adequacy for the required 10 year - 6 hour precipitation event, as shown on Table 10 of this Appendix.

Culverts carrying disturbed drainage are designed with a C number (i.e. C-1). Contributing watersheds for disturbed area culverts (and ditches) are designated with a WSDD number (i.e. WSDD-1) shown on Plate 7-5. All disturbed area drainage culverts have been designed to carry the runoff from a 10 year - 24 hour precipitation event. All calculations and design criteria are included in this Appendix.

Existing culverts C-2, C-8 and C-10 will be removed during the pad extension, and therefore are not included in this Appendix. These culverts are shown on Plate 7-5C, dated 03/21/91.

All culverts will be inspected regularly, and cleaned as necessary to provide for passage of design flows. Inlets and outlets shall also be maintained to prevent plugging, undue restriction of water flow and erosion. Culvert outlets will be rip-rapped where necessary to protect from erosion.

One culvert, UD-1, is considered a permanent diversion, and will remain in place after reclamation. This culvert is sized to carry runoff in-excess of a 100 year - 6 hour storm. Justification for leaving it in place is provided in the Reclamation Hydrology Section 4.1, of this Appendix.

All other culverts are considered temporary, and will be removed upon final reclamation, with the exception of the lower 300' of the Main Canyon Culvert. This portion of the culvert will be left in place until the sediment pond is removed during Phase II Reclamation. The remaining portion of the culvert will be removed at that time.

2.10 Ditches

The proposed pad expansion will necessitate modifications to hydrologic structures, including ditches. As a result of the expansion, existing ditch DD-9 will be eliminated. Two new ditches (DD-12 and DD-13) will be added to provide drainage control for the expanded facility. All other existing ditches on the site will remain unchanged.

Undisturbed diversions are designated with a UD number (i.e. UD-2). There is only one undisturbed diversion ditch - (UD-2). This ditch is existing. Contributing watersheds for the undisturbed diversion are labelled with a WSUD number (i.e. WSUD-2), and are shown on Plate 7-5C.

Disturbed diversions (ditches) are designated with a DD number (i.e. DD-1). Contributing watersheds for disturbed diversions are labelled with a WSDD number (i.e. WSDD-1) as shown on Plates 7-5 and 7-5C. All disturbed diversions carry runoff which ultimately goes to the sediment pond.

All ditches are designed to carry the expected runoff from respective watersheds from a 10 year - 6 hour precipitation event, with a minimum freeboard of 0.3'. Ditches were assumed to be unlined with a Manning's No. of 0.035. All ditches have been conservatively evaluated for size using the computer program "Office of Surface Mining Watershed Model," Storm, Version 6.21, by Gary E. M^cIntosh, to calculate peak flows, which were then routed into triangular shaped channels with 1:1 side slopes. This evaluation shows conditions which are not uncommon at minesites and which tend to maximize required flow depths. All ditches are designed with the steeper (1:1) side slopes to allow for maintenance by road grading or other equipment. Actual side slopes may vary in the field; however, as long as the ditch has the

required depth and cross-sectional area to carry the flow with required freeboard, the ditch is adequate.

Ditches with flow velocities of 5 fps or greater will be lined with properly sized rip-rap or other controls to protect from erosion.

All ditch slopes and lengths were taken from Plate 7-5, "Drainage Map".

A typical ditch section, as well as a summary of flow depths and sizes is provided in Figure 3 of this Appendix.

All ditches will be inspected regularly, constructed and maintained to the minimum dimensions to provide adequate capacity for the design flow. All ditches are temporary and will be removed during final reclamation.

Note: Ditches were also evaluated for adequacy to carry runoff from the 10 year - 24 hour precipitation event.

2.11 Main Canyon Culvert

The proposed main canyon culvert will be placed to closely approximate the existing stream alignment. In an effort to protect the natural channel, the area will be covered with a filter fabric (geotextile material). An underdrain will then be installed on the fabric, consisting of an 18" perforated drain pipe surrounded by a bed of clean 2" drain drainrock. The underdrain will be covered by a second layer of fabric which in turn will be covered with a layer of marker material used to facilitate visibility during final reclamation. A layer of bedding material will then be placed over the marker material. The proposed 72" cmp culvert will then be installed on the bedding material and backfilled and compacted throughout the length of the mine site - approximately 1500'.

The culvert has been sized to safely carry the runoff from a 100 year - 6 hour precipitation event for all of Crandall Canyon above the minesite. The 100 year - 6 hour flow has been calculated at 222.79 cfs, as shown on Table 3. This flow can be carried by a 3.75' minimum diameter culvert, as calculated by the Manning's Equation and shown in Table 10; therefore, the proposed 6' diameter culvert is more than adequate.

There have been some questions raised as to previous main canyon flow calculations which showed the expected runoff from the 100 year - 6 hour storm to be as high as 431 cfs. It appears this number was generated by using a computer program called "Peak", using slightly different parameters than those used in this report.

The runoff numbers in this Appendix were calculated using the "Office of Surface Mining Watershed Model", Storm Version 6.21, by Gary E. McIntosh. All flows were based on the SCS-TR55 Method for Type II storms. This program has been supplied to the operators by the Division, and results have been consistently accepted by the agencies.

In an effort to make the runoff values more conservative, yet realistic, for design purposes, some parameters, such as concentration time and SCS Upland Curve numbers were placed on the conservative side in the program. Based on these numbers, a very conservative flow of 222.79 cfs was obtained. It should be noted that this flow agrees closely with a previous calculation using the equation of Thomas and Lindskov (1983), which estimates the 100 year - 6 hour flow for the main canyon at 272 cfs.

Summary: It is obvious that the final number on the main channel flow is entirely dependent upon which computer program or method is used. Since the OSM Storm program has been used throughout calculations for this plan, and since it is a widely accepted method, the more conservative figure of 222.79 cfs has been used in design calculations for this plan.

2.12 Main Canyon Culvert Inlet Structure

The culvert inlet will be protected by an inlet section and trash rack, along with a rip-rapped headwall. An additional trash rack will be installed upstream of the inlet at a location convenient for maintenance and cleanout, as shown on Figure 10. Based on the Culvert Nomograph, Figure 1, the expected flow will enter the culvert at slightly over 1 diameter of head; therefore, additional headwall protection will be provided for a minimum of 5' above and around the inlet structure. Headwall protection will be of 18" D_{50} rip-rap, as shown on Figure 10.

A small side drainage enters Crandall Creek just west of the bypass culvert inlet. As the drainage calculations took into consideration the runoff from this side canyon, the bypass culvert and inlet riprap are adequately sized to handle drainage from this side canyon. The riprap has been extended up this drainage for a short distance (see Map 5-3) in order to protect the culvert inlet.

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2.13 Main Canyon Culvert - Outlet Structure

The outlet of the 6' diameter main canyon culvert has been designed to flow into a rip-rap apron to protect against scouring and for energy dissipation. The rip-rap apron is designed to fit the natural channel configuration as closely as possible, and will allow runoff to re-enter the natural channel at a reduced velocity which is no greater than natural flow conditions. Runoff from the 100 year - 6 hour precipitation event in the canyon above the minesite has been calculated at 222.79 cfs.

The rip-rap apron design is based on Figure 7-26, Design of Outlet Protection - Maximum Tailwater Condition, "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983. Based on the figure, the apron should be a minimum of 22' in length, widening from 6' to 15', with a 0% slope. The proposed length has been increased to 30', with an 18' width, to ensure adequate time for velocity reduction. The slope is kept at 0%. Rip-rap size is conservatively placed at 30" D_{50}. Rip-rap will be placed to a depth of 1.5 D_{50} and will be embedded in a 12" layer of 2" drain rock filter. Rip-rap will also be placed on 1:1 side slopes to the height of the culvert (6') at the culvert outlet tapering to 3' at the outlet of the apron. This rip rap apron has been sized and designed to adequately dissipate energy from flow velocities of a 100 year, 24 hour precipitation event and resist dislodgement. The drain rock filter bed will also serve to secure the rip rap boulders firmly in place, to add an additional element of stability, and prevent scouring underneath the boulder bed.

The natural channel below the proposed outlet has been measured from field surveys to have a bottom width of approximately 17' at the proposed apron outlet, with side slopes approximately 1:1. When the flow is routed from the culvert across the apron to the natural channel, the velocity is reduced from 21.70 fps at the culvert outlet to 10.83 fps at the outlet of the apron. Refer to 72" Culvert Outlet Rip-Rap Apron Flow Velocity Calculations in Section 4.6. Based on actual field measurements, the

natural channel flow velocity would be approximately 11.02 fps at this location with the same flow of 222.79 cfs. Therefore, the velocity of the stream flow exiting the rip rap apron will be less than the velocity in the naturally existing stream bed, at that location, under similar conditions.

TABLE 1
WATERSHED SUMMARY

Watershed	*Type*	*CN*	*Acres*	*Drains To*		*Final*
Crandall	*Undisturbed*	*69*	*3480.00*	*Main Culvert*	-	*Crandall Creek*
WSUD-1	*Undisturbed*	*69*	*84.88*	*Culvert UD-1*	-	*Crandall Creek*
WSUD-2	*Undisturbed*	*69*	*1.39*	*Ditch UD-2*	-	*Culvert UD-1*
WSUD-3	*Undisturbed*	*69*	*8.66*	*Culvert UD-3*	-	*Natural Drainage*
WSDD-1	*Undisturbed*	*69*	*0.14*	*Ditch DD-1*	-	*Sediment Pond*
WSDD-1	*Reclaimed*	*75*	*0.08*	*Ditch DD-1*	-	*Sediment Pond*
WSDD-2	*Reclaimed*	*75*	*0.15*	*Ditch DD-1*	-	*Sediment Pond*
WSDD-3	*Undisturbed*	*69*	*0.13*	*Ditch DD-3*	-	*Sediment Pond*
WSDD-3	*Reclaimed*	*75*	*0.15*	*Ditch DD-3*	-	*Sediment Pond*
WSDD-3	*Disturbed*	*90*	*0.26*	*Ditch DD-3*	-	*Sediment Pond*
WSDD-3	*Paved*	*95*	*0.33*	*Ditch DD-3*	-	*Sediment Pond*
WSDD-4	*Paved Road*	*95*	*0.11*	*Ditch DD-4*	-	*Sediment Pond*
WSDD-4	*Disturbed*	*90*	*0.08*	*Ditch DD-4*	-	*Sediment Pond*
WSDD-5	*Undisturbed*	*69*	*0.12*	*Ditch DD-5*	-	*Sediment Pond*
WSDD-5	*Reclaimed*	*75*	*0.33*	*Ditch DD-5*	-	*Sediment Pond*
WSDD-5	*Paved Road*	*95*	*0.33*	*Ditch DD-5*	-	*Sediment Pond*
WSDD-7	*Undisturbed*	*69*	*0.18*	*Ditch DD-7*	-	*Sediment Pond*
WSDD-7	*Disturbed*	*90*	*0.17*	*Ditch DD-7*	-	*Sediment Pond*
WSDD-7	*Paved Road*	*95*	*0.09*	*Ditch DD-7*	-	*Sediment Pond*
WSDD-8	*Undisturbed*	*69*	*3.59*	*Ditch DD-8*	-	*Sediment Pond*
WSDD-8	*Reclaimed*	*75*	*0.15*	*Ditch DD-8*	-	*Sediment Pond*
WSDD-8	*Disturbed*	*90*	*0.37*	*Ditch DD-8*	-	*Sediment Pond*
WSDD-8	*Paved Road*	*95*	*0.25*	*Ditch DD-8*	-	*Sediment Pond*
WSDD-10	*Undisturbed*	*69*	*0.07*	*Culvert C-4*	-	*Sediment Pond*
WSDD-10	*Reclaimed*	*75*	*0.12*	*Culvert C-4*	-	*Sediment Pond*
WSDD-10	*Disturbed*	*90*	*0.61*	*Culvert C-4*	-	*Sediment Pond*
WSDD-10	*Paved Road*	*95*	*0.27*	*Culvert C-4*	-	*Sediment Pond*
WSDD-11	*Undisturbed*	*69*	*2.09*	*Ditch DD-11*	-	*Sediment Pond*
WSDD-11	*Reclaimed*	*75*	*0.15*	*Ditch DD-11*	-	*Sediment Pond*
WSDD-11	*Disturbed*	*90*	*0.04*	*Ditch DD-11*	-	*Sediment Pond*
WSDD-12	*Undisturbed*	*60*	*8.82*	*Ditch DD-12*	-	*Sediment Pond*
WSDD-12	*Disturbed*	*90*	*2.29*	*Ditch DD-12*	-	*Sediment Pond*
WSDD-13	*Undisturbed*	*60*	*17.72*	*Ditch DD-13*	-	*Sediment Pond*
WSDD-13	*Disturbed*	*90*	*3.70*	*Ditch DD-13*	-	*Sediment Pond*
WSDD-13	*Paved*	*95*	*0.27*	*Ditch DD-13*	-	*Sediment Pond*
WSDD-14	*Disturbed*	*90*	*0.89*	*Sediment Pond*	-	*Sediment Pond*
WSDD-14	*Undisturbed*	*60*	*0.78*	*Sediment Pond*	-	*Sediment Pond*
WSDD-14	*Paved*	*95*	*0.02*	*Sediment Pond*	-	*Sediment Pond*
WSDD-15	*Paved*	*95*	*0.09*	*Ditch DD-7*	-	*Sediment Pond*

TABLE 2
WATERSHED PARAMETERS

Watershed	Type	CN	Acres	Hyd. Length (ft.)	Land Slope (%)	Elev. Change(ft.)
Crandall	Und.	69	3480.00	16,500	17.58	2900
WSUD-1	Und.	69	84.88	3,100	53.55	1660
WSUD-2	Und.	69	1.39	320	78.13	250
WSUD-3	Und.	69	8.66	1300	70.77	920
WSDD-1	Und.	69	0.14	100	40.00	40
WSDD-1	Recl.	75	0.08	120	25.00	30
WSDD-2	Recl.	75	0.15	200	25.00	50
WSDD-3	Und.	69	0.13	80	50.00	40
WSDD-3	Recl.	75	0.15	100	48.00	48
WSDD-3	Dist.	90	0.26	125	56.00	70
WSDD-3	Paved	95	0.33	100	3.00	3
WSDD-4	Paved	95	0.11	250	8.33	20
WSDD-4	Dist.	90	0.08	100	10.00	10
WSDD-5	Und.	69	0.12	60	50.00	30
WSDD-5	Recl.	75	0.33	80	50.00	40
WSDD-5	Paved	95	0.33	300	8.33	25
WSDD-7	Und.	69	0.18	100	78.00	78
WSDD-7	Dist.	90	0.17	120	66.67	80
WSDD-8	Und.	69	3.59	700	65.71	460
WSDD-8	Recl.	75	0.15	80	62.50	50
WSDD-8	Dist.	90	0.37	60	65.71	39
WSDD-8	Paved	95	0.25	560	5.36	30
WSDD-10	Und.	69	0.07	45	62.22	28
WSDD-10	Recl.	75	0.12	50	72.00	36
WSDD-10	Dist.	90	0.61	120	62.50	75
WSDD-10	Paved	95	0.27	335	5.37	18
WSDD-11	Und.	69	2.09	570	64.91	370
WSDD-11	Recl.	75	0.15	30	66.67	20
WSDD-11	Dist.	90	0.04	35	66.67	23
WSDD-12	Und.	60	8.82	1600	42.50	680
WSDD-12	Dist.	90	2.29	80	72.73	58
WSDD-13	Und.	60	17.72	2100	53.81	1130
WSDD-13	Dist.	90	3.70	650	9.09	59
WSDD-13	Paved	95	0.27	40	4.00	2
WSDD-14	Dist.	90	0.89	140	16.11	23
WSDD-14	Und.	60	0.78	380	64.41	245
WSDD-14	Paved	95	0.02	30	3.00	1
WSDD-15	Paved	95	0.09	150	3.33	5

TABLE 3
RUNOFF SUMMARY
UNDISTURBED DIVERSIONS

Diversion	*Main Culvert*	*UD-1*	*UD-2*	*UD-3*
Watershed	*Crandall Canyon*	*WSUD-1*	*WSUD-2*	*WSUD-3*
Area (Acres)	*3480.0*	*84.88*	*1.39*	*8.66*
Runoff CN	*69*	*69*	*69*	*69*
10 year/6 hour Rainfall (in.)	*1.55*	*1.55*	*1.55*	*1.55*
Peak Flow 10/6 (cfs)	*N/A*	*1.91*	*0.04*	*0.23*
25 year/6 hour Rainfall (in.)	*1.90*	*1.90*	*1.90*	*1.90*
Peak Flow 25/6 (cfs)	*N/A*	*3.68*	*0.08*	*0.43*
100 year/6 hour Rainfall (in.)	*2.40*	*2.40*	*2.40*	*2.40*
Peak Flow 100/6 (cfs)	*222.79*	*6.81*	*0.21*	*0.89*
10 year/24 hour Rainfall (in.)	*N/A*	*2.50*	*2.50*	*2.50*
Runoff Volume 10/24 (ac.ft.)	*N/A*	*2.98*	*0.05*	*0.30*

TABLE 4
RUNOFF SUMMARY
DRAINAGE TO SEDIMENT POND

Watershed	*Type*	*10 year/24 hour Volume-ac.ft.*	*10 year/24 hour Peak Flow-cfs*	*10 year/6 hour Peak Flow-cfs*	*25 year/6 hour Peak Flow-cfs*
WSDD-1	*Undisturbed*	*0.02*	*0.10*	*0.04*	*0.06*
WSDD-1	*Reclaimed*	*0.01*	*0.04*	*0.01*	*0.01*
WSDD-2	*Reclaimed*	*0.01*	*0.06*	*0.01*	*0.03*
WSDD-3	*Undisturbed*	*0.00*	*0.03*	*0.00*	*0.01*
WSDD-3	*Reclaimed*	*0.01*	*0.05*	*0.01*	*0.02*
WSDD-3	*Disturbed*	*0.03*	*0.18*	*0.08*	*0.12*
WSDD-3	*Paved*	*0.05*	*0.32*	*0.17*	*0.22*
WSDD-4	*Paved*	*0.02*	*0.12*	*0.07*	*0.09*
WSDD-4	*Disturbed*	*0.01*	*0.08*	*0.04*	*0.05*
WSDD-5	*Undisturbed*	*0.00*	*0.03*	*0.00*	*0.01*
WSDD-5	*Reclaimed*	*0.02*	*0.10*	*0.02*	*0.04*
WSDD-5	*Paved*	*0.05*	*0.39*	*0.21*	*0.27*
WSDD-7	*Undisturbed*	*0.01*	*0.05*	*0.00*	*0.01*
WSDD-7	*Disturbed*	*0.02*	*0.12*	*0.05*	*0.07*
WSDD-8	*Undisturbed*	*0.13*	*0.75*	*0.10*	*0.20*
WSDD-8	*Reclaimed*	*0.01*	*0.05*	*0.01*	*0.02*
WSDD-8	*Disturbed*	*0.05*	*0.23*	*0.10*	*0.14*
WSDD-8	*Paved*	*0.04*	*0.37*	*0.20*	*0.26*
WSDD-10	*Undisturbed*	*0.00*	*0.03*	*0.00*	*0.01*
WSDD-10	*Reclaimed*	*0.01*	*0.03*	*0.01*	*0.01*
WSDD-10	*Disturbed*	*0.08*	*0.42*	*0.19*	*0.27*
WSDD-10	*Paved*	*0.04*	*0.35*	*0.19*	*0.24*
WSDD-11	*Undisturbed*	*0.07*	*0.47*	*0.06*	*0.12*
WSDD-11	*Reclaimed*	*0.01*	*0.04*	*0.01*	*0.02*
WSDD-11	*Disturbed*	*0.01*	*0.06*	*0.03*	*0.04*
WSDD-12	*Undisturbed*	*0.13*	*0.25*	*0.04*	*0.16*
WSDD-12	*Disturbed*	*0.29*	*3.33*	*1.51*	*2.10*
WSDD-13	*Undisturbed*	*0.26*	*0.49*	*0.07*	*0.30*
WSDD-13	*Disturbed*	*0.47*	*5.39*	*2.44*	*3.39*
WSDD-13	*Paved*	*0.04*	*0.20*	*0.11*	*0.14*
WSDD-14	*Disturbed*	*0.11*	*0.78*	*0.35*	*0.49*
WSDD-14	*Undisturbed*	*0.01*	*0.03*	*0.00*	*0.02*
WSDD-14	*Paved*	*0.02*	*0.07*	*0.04*	*0.05*
WSDD-15	*Paved*	*0.02*	*0.11*	*0.06*	*0.08*
Totals		*2.06*	*15.13*	*6.23*	*9.07*

TABLE 5
RUNOFF CONTROL STRUCTURE
WATERSHED SUMMARY

Structure	*Type*	*Contributing Watersheds*
Main Culvert	*Culvert*	*Crandall Canyon Above Mine*
UD-1	*Culvert*	*WSUD-1*
UD-2	*Culvert*	*WSUD-2*
UD-3	*Culvert*	*WSUD-3*
DD-1	*Ditch*	*WSDD-1, WSDD-2*
DD-3	*Ditch*	*WSDD-1, WSDD-2, WSDD-3*
DD-4	*Ditch*	*WSDD-1, WSDD-2, WSDD-3, WSDD-4, WSDD-8, WSDD-12*
DD-5	*Ditch*	*WSDD-1, WSDD-2, WSDD-3, WSDD-4, WSDD-5, WSDD-8, WSDD-12*
DD-7	*Ditch*	*WSDD-7, WSDD-11*
DD-8	*Ditch*	*WSDD-8*
DD-11	*Ditch*	*WSDD-11*
DD-12	*Ditch*	*WSDD-12*
DD-13	*Ditch*	*WSDD-13*
DD-14	*Sheet Flow*	*WSDD-14*
C-1	*Culvert*	*WSDD-1, WSDD-2, WSDD-3, WSDD-8*
C-3	*Culvert*	*WSDD-7, WSDD-11, WSDD-15*
C-4	*Culvert*	*WSDD-10*
C-5	*Culvert*	*WSDD-11*
C-6	*Culvert*	*WSUD-2*
C-7	*Culvert*	*WSDD-1, WSDD-2, WSDD-3*
C-9	*Culvert*	*WSDD-4, WSDD-12*
C-11	*Culvert*	*WSDD-12*
C-11A	*Culvert*	*WSDD-12*
C-12	*Culvert*	*WSDD-1, 2, 3, 4, 5, 8, 12*
C-13	*Culvert*	*WSDD-13*
C-14	*Slot Culvert*	*WSDD-4*
C-15	*Slot Culvert*	*WSDD-15*
C-16	*Culvert*	*WSDD-13*
C-17	*Culvert*	*WSDD-13*
Sediment Pond	*Pond*	*WSDD-1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14*

TABLE 6
RUNOFF CONTROL STRUCTURE
FLOW SUMMARY

Structure	Type	10 year/6 hour Peak Flow-cfs	10 year/24 hour Peak Flow-cfs	25 year/6 hour Peak Flow-cfs	100 year/6 hour Peak Flow-cfs
Main Culvert	Culvert	-	-	-	222.79
UD-1	Culvert	1.91	-	3.68	6.81
UD-2	Ditch	0.04	-	0.08	0.21
UD-3	Culvert	0.23	-	0.43	0.89
DD-1	Ditch	0.06	0.20	0.10	-
DD-3	Ditch	0.32	0.78	0.47	-
DD-4	Ditch	2.39	5.96	3.49	-
DD-5	Ditch	2.62	6.48	3.81	-
DD-7	Ditch	0.21	0.85	0.34	-
DD-8	Ditch	0.41	1.40	0.62	-
DD-11	Ditch	0.10	0.57	0.18	-
DD-12	Ditch	1.55	3.58	2.26	-
DD-13	Ditch	2.62	6.08	3.83	-
DD-14	Sht Flw	0.39	0.88	0.56	-
C-1	Culvert	0.73	2.18	1.09	-
C-3	Culvert	0.21	0.85	0.34	-
C-4	Culvert	3.01	6.79	4.02	-
C-5	Culvert	0.10	0.57	0.18	-
C-6	Culvert	0.04	-	0.08	-
C-7	Culvert	0.32	0.78	0.47	-
C-9	Culvert	0.11	0.20	0.14	-
C-11	Culvert	1.55	3.58	2.26	-
C-11A	Culvert	1.55	3.58	2.26	-
C-12	Culvert	2.62	5.96	3.49	-
C-13	Culvert	2.62	6.08	3.83	-
C-14	Slot Cul.	0.11	0.20	0.14	-
C-15	Slot Cul.	0.06	0.11	0.08	-
C-16	Culvert	2.62	6.08	3.83	-
C-17	Culvert	2.62	6.08	3.83	-
Sediment Pond	Pond	6.23	15.13	9.07	-

TABLE 7
DISTURBED DITCH DESIGN SUMMARY

Ditch	DD-1	DD-3	DD-4	DD-5	DD-7	DD-8	DD-11
Slope (%)	30.77	3.00	11.91	4.50	3.33	3.59	3.00
Length (ft.)	130	75	168	628	142	557	173
Manning's No.	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Side Slope (H:V)	1:1	1:1	1:1	1:1	1:1	1:1	1:1
*Bottom Width (ft.)	0	0	0	0	0	0	0
Peak Flow 10/6 (cfs)	0.06	0.32	2.39	2.62	0.21	0.41	0.10
Peak Flow 10/24 (cfs)	0.20	0.78	5.96	6.48	0.85	1.40	0.57
Flow Depth (ft.) 10/6	0.14	0.40	0.66	0.75	0.33	0.47	0.26
Flow Depth (ft.) 10/24	0.22	0.56	0.92	1.06	0.57	0.67	0.50
Flow Area (ft^2)10/6	0.02	0.16	0.43	0.57	0.11	0.18	0.07
Flow Area (ft^2)10/24	0.05	0.31	0.85	1.12	0.32	0.45	0.25
Velocity (fps)10/6	3.15	2.00	5.55	4.61	1.87	2.28	1.50
Velocity (fps) 10/24	4.26	2.50	6.97	5.78	2.66	3.10	2.31
Rip-Rap Req'd (Y/N)	N	N	Y	N	N	N	N
Rip-Rap D_{50}	-	-	6"	-	-	-	-

* All ditches are triangular.
Note: Slope/Lengths from Plate 7-5.

TABLE 7
(Continued)
DISTURBED DITCH DESIGN SUMMARY

Ditch	DD-12	DD-13 (MIN.)	DD-13 (MAX.)
Slope (%)	3.29	1.79	50.00
Length (ft.)	50	280	80
Manning's No.	0.035	0.035	0.035
Side Slope (H:V)	1:1	1:1	2:1
Bottom Width (ft.)	0	0	2
Peak Flow 10/6 (cfs)	1.55	2.62	2.62
Peak Flow 10/24 (cfs)	3.58	6.08	6.08
Flow Depth (ft.) 10/6	0.71	0.97	0.15
Flow Depth (ft.) 10/24	0.97	1.33	0.24
Flow Area (ft^2) 10/6	0.50	0.94	0.34
Flow Area (ft^2) 10/24	0.94	1.77	0.60
Velocity (fps) 10/6	3.07	2.79	7.66
Velocity (fps) 10/24	3.79	3.44	10.12
Rip-Rap Req'd (Y/N)	N	N	Y
Rip-Rap D_{50}	-	-	9"

* All ditches are triangular.

Note: Slope/Lengths from Plate 7-5.

Note: DD-12 is shortened due to construction of the south portal access ramp/fan pad.

TABLE 8
UNDISTURBED DITCH DESIGN SUMMARY

Ditch	*UD-2*
Slope (%)	*12.5*
Length (ft.)	*400*
Manning's No.	*0.035*
Side Slope (H:V)	*1:1*
Bottom Width (ft.)	*0*
Peak Flow-10/6 (cfs)	*0.04*
Flow Depth (ft.)	*0.14*
Flow Area (ft^2)	*0.02*
Velocity (fps)	*2.03*
Lined (Y/N)	*N*
Rip-Rap Req'd (Y/N)	*N*

Note: Slope/Lengths from Plate 7-5.

TABLE 9
DISTURBED CULVERT DESIGN SUMMARY

Culvert	C-1	C-3	C-4	C-5	C-6	C-7	C-9	C-11	C-11A	C-12	C-13	C-14	C-15	C-16	C-17
Slope (%)	16.67	8.00	25.07	57.14	17.20	3.00	3.50	3.50	1.50	4.50	3.00	1.00	1.00	25.00	20.00
Length (ft.)	60	360	69	120	12	80	18	30	60	330	100	40	30	40	60
Manning's No.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Peak Flow 10/6 (cfs)	0.73	0.21	3.01	0.10	0.04	0.32	0.11	1.55	1.55	2.62	2.62	0.11	0.06	2.62	2.62
Peak Flow 10/24 (cfs)	2.18	0.85	6.79	0.57	N/A	0.78	0.20	3.58	3.58	5.96	6.08	0.20	0.11	6.08	6.08
Min. Diam. Req'd (ft.) 10/6	0.41	0.28	0.60	0.14	0.13	0.39	0.25	0.68	0.80	0.79	0.85	0.32	0.25	0.57	0.60
Min. Diam. Req'd (ft.) 10/24	0.62	0.46	0.82	0.28	N/A	0.54	0.32	0.93	1.09	1.08	1.17	0.40	0.32	0.79	0.82
Diam. Installed (ft.)	1.50	2.00	2.00	1.00	1.00	1.00	1.00	1.50	1.50	2.00	2.00	1.00	1.00	1.67	1.50
Velocity (fps) 10/6	5.55	3.53	10.54	6.13	3.11	2.71	2.20	4.27	3.10	5.35	4.59	1.38	1.18	10.17	9.35
Velocity (fps) 10/24	7.30	5.01	12.91	9.47	N/A	3.39	2.56	5.26	3.83	6.56	5.67	1.60	1.38	12.55	11.54
Rip-Rap D_{50}	6"	-	12"	6"	-	-	-	-	-	6"	-	-	-	12"	12"

Note: Slope/Lengths from Plate 7-5.

Source: (Haestad Methods, Flowmaster I, Version 3.42)

TABLE 10
UNDISTURBED CULVERT DESIGN SUMMARY

Culvert	**Main Canyon*	*UD-1*	*UD-3*
Slope (%)	*8.00*	*23.33*	*11.96*
Length (ft.)	*1500*	*270*	*460*
Manning's No.	*0.02*	*0.02*	*0.02*
Peak Flow 100/6 (cfs)	*222.79*	-	-
Peak Flow 10/6 (cfs)	-	*1.91*	*0.23*
Min. Diam. Req'd (ft.)	*3.75*	*0.52*	*0.26*
Diam. Installed (ft.)	*6.00*	*3.50*	*2.00*
Velocity (fps)	*20.14*	*9.16*	*4.20*

* *Culvert to be installed under expansion plan.*
All other undisturbed culverts are existing.

Note: Slope/Lengths from Plate 7-5.
Source: (Haestad Methods, Flowmaster I, Version 3.43)

DESIGN OF SEDIMENT CONTROL STRUCTURES

Design Specifications:

Tables:

Figures:

3.1 Design Specification for Expanded Sediment Pond

The sedimentation pond located in Crandall Canyon has been redesigned and reconstructed to control the additional storm runoff from the pad extension and from the undisturbed drainage areas above the pad extension. The "As-Constructed" topography and cross sections of the pond design are shown on Plate 7-3.

The pond has been sized to meet the requirements of R645-301-742.221.33 (DOGM), which stipulates that sedimentation ponds be capable of containing or treating the 10-year 24-hour precipitation event. According to Miller, et al (1973), the 10-year, 24-hour design storm for Crandall Canyon is 2.5 inches. The design storm calculations for the sedimentation pond are presented in Table 4 of this Appendix. These calculations include the proposed pad extension, the additional watersheds above the pad extension, the existing pad and reclaimed areas, and the undisturbed watersheds above the existing pad.

As required by R645-301-742.223, the 25 year-6 hour precipitation event was routed through the sedimentation pond to determine the adequacy of the spillway. Overflow from the pond is discharged to Crandall Creek. Total precipitation from the 25 year-6 hour storm is 1.9 inches (Miller, et al, 1973). The 25 year-6 hour flow is calculated at 9.07 cfs. Based on the calculations, the primary spillway is more than adequate to carry the expected runoff from a 25 year-6 hour event.

3.2 Sediment Yield

The Universal Soil Equation (USLE) was used to estimate sediment yield from all drainage areas contributing to the pond. All soil loss from this area was assumed to be delivered to, and deposited in the sedimentation pond.

Erosion rate (A) in tons-per-acre-per-year is determined using the USLE as follows:

$$A = (R)\ (K)\ (LS)\ (CP)$$

Where the variables R, K, LS, and CP are defined as follows:

Variable "R" is the rainfall factor which can be estimated from $R = 27P^{2.2}$*; where P is the 2-year, 6-hour precipitation value. P for the Crandall Canyon area is estimated at 1.00" based on Figure 5.4, page 315, Barfield, et.al. 1983. Therefore, the estimated value of "R" for this area is 27.00.*

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value is taken as 0.06 as determined from soils samples and shown on the soil erodibility chart, Figure 4. K is estimated to be 0.15 for undisturbed and reclaimed areas, based on soils data and the soil erodibility chart, Figure 5.

Variable "LS" is the length-slope factor. This figure was determined by calculating a weighted average slope length and percentage for the undisturbed, reclaimed and disturbed areas, respectively. The slope length and percentage were then substituted into the following equation to determine the LS Factor:

$$LS=\left(\frac{\pi}{72.6}\right)^{m}\left(\frac{430\ x^2+\ 30\ x+\ 0.43}{6.613}\right)$$

where:

π	=	*Field slope length in feet;*
^{m}	=	*0.5 if S is 5% or greater;*
x	=	*sin* θ;
θ	=	*Angle of slope in degrees.*

Variable "CP" is the control practice factor, which can be divided into a cover and practice factor. Values were determined from Appendix 5A, Barfield, et.al., 1983.

Site	*CP Factor*
Disturbed Areas	*1.20*
Reclaimed Areas	*0.100*
Undisturbed Areas	*0.003*

The sediment volume is based on a density of 100 pounds per cubic foot of sediment.

SEDIMENT YIELD CALCULATIONS - USLE

Drainage	*R*	*K*	*Acres*	*Slope Length Feet*	*%*	*LS*	*CP*	*A**	*Yield***
Undisturbed	*27.00*	*0.15*	*33.59*	*1700*	*53*	*79.60*	*0.003*	*00.967*	*0.015*
Reclaimed	*27.00*	*0.15*	*1.22*	*90*	*52*	*17.81*	*0.10*	*07.213*	*0.004*
Disturbed	*27.00*	*0.06*	*8.92*	*350*	*26*	*11.69*	*1.200*	*22.725*	*0.093*

Total Sediment 1 year (ac.ft.).....0.112

Total Sediment 3 years (ac. ft.). 0.336

* *A = tons/acre-year*
** *Yield = acre-ft/year*

3.3 Sediment Pond Volume

The volumes shown in Table 11 are from the volumes calculated from the precipitation, runoff and sediment yield for a 10 year-24 hour precipitation event. The volumes were calculated based on the disturbed areas (and contributing undisturbed areas) runoff values, developed using the design parameters described in this section.

The sediment pond has been reconstructed, and the sediment pond volumes on Table 11, Table 12 and Figure 6 all represent the "As-Constructed" pond.

Expanded Area Pond Requirement

3 Year Sediment Storage

TABLE 11
SEDIMENT POND DESIGN

1.	*Use 2.50" for 10 year-24 hour event.*	
2.	*Runoff Volume (from Table 4, 10 yr/24 hr) =*	*2.060 ac. ft.*
3.	*Sediment Storage Volume*	
	USLE 0.112 ac.ft./yr. x 3 yrs. =	*0.336 ac. ft.*
4.	*Direct Precipitation into Pond*	
	0.441 acres x 2.50" / 12 in./ft. =	*0.092 ac. ft.*
5.	*Total Required Pond Volume*	
	2.060 + 0.336 + 0.092 =	*2.488 ac. ft.*
*6.**	*Peak Flow (25 yr. - 6 hr. event) =*	*9.070 cfs*
7.	*Pond Design Volume @ Principle Spillway = (See Table 12)*	*3.572 ac. ft.*

* *Peak Flow values from Table 4.*

TABLE 12
SEDIMENT POND
STAGE / VOLUME DATA

Elev.	*Area*	*Volume*	*Acc. Volume (ac.ft.)*	*Remarks*
7766	*1756.67*	*.0000*	*.0000*	*Bottom of Pond*
7767	*3706.92*	*2731.80*	*0.063*	
7768	*5119.14*	*4413.03*	*0.164*	
7769	*5857.00*	*5488.07*	*0.290*	*Sediment Cleanout Level*
7770	*6949.54*	*6403.32*	*0.437*	*Maximum Sediment Level*
7771	*7806.54*	*7378.14*	*0.606*	
7772	*8894.51*	*8350.53*	*0.798*	
7773	*9905.02*	*9399.77*	*1.014*	
7774	*11055.91*	*10480.47*	*1.254*	
7775	*12153.06*	*11604.49*	*1.520*	
7776	*13120.22*	*12636.64*	*1.810*	
7777	*14084.05*	*13602.14*	*2.123*	
7778	*15043.33*	*14563.69*	*2.457*	
7779	*15984.66*	*15514.00*	*2.813*	
7780	*16934.94*	*16459.15*	*3.191*	
7780.81	*17669.26*	*14014.70*	*3.513*	*Principal Spillway*
7781	*17868.13*	*3376.05*	*3.591*	
7781.81	*18661.53*	*15028.20*	*3.936*	*Emergency Spillway*
7782	*18848.42*	*3430.08*	*4.012*	
7783	*19886.14*	*19367.28*	*4.457*	
7784	*21113.55*	*20499.85*	*4.927*	
7785	*22110.39*	*21611.97*	*5.423*	*Top of Embankment*

TABLE 13
SEDIMENT POND
STAGE / DISCHARGE DATA

Head (ft.)	Q (cfs) Weir Controlled	Q (cfs) Orfice Controlled	Q (cfs) Pipe Flow Controlled
0.0	-	-	-
0.2	1.69	6.77	17.14
0.4	4.77	9.57	17.32
0.6	8.76	11.72	17.50
0.8	13.49	13.53	17.68
1.0	18.85	15.13	17.86

Note: 1- 25 year-6 hour flow = 9.070 cfs.

2- Flow will be weir controlled at a head of 0.62' over riser inlet.

Weir Controlled

$Q = CLH^{1.5}$; where : C = 3.0, L = Circumference of Riser = 6.2832'

Orifice Controlled

$Q = C'a\ (2gH)^{0.5}$; where : C = 0.6, a = Area of Riser = 3.1416 ft^2, g = 32.2 ft/sec^2

Pipe Flow Controlled

$$Q = \frac{a\ (2gH')0.5}{(1+Ke+Kb+KcL)^{0.5}}$$; where a = Area of Pipe = 1.77 ft^2

H' = Head = H + 9.1 (At outlet of Riser)

Ke = 1.0

Kb = 0.5

Kc = 0.043

L = 90'

3.4 Sediment Pond Summary

a) The sedimentation pond has been designed to contain the disturbed area (and contributing undisturbed area) runoff from a 10 year-24 hour precipitation event, along with 3 years of sediment storage capacity. Runoff to the pond will be directed by various ditches and culverts as described in the plan.

b) The required volume for the sediment pond is calculated at 2.488 acre feet, including 3 years of sediment storage. The existing sediment pond size will be a volume of approximately 3.988 acre feet (at the principle spillway), which is more than adequate. Existing decant and spillway design will not be modified for the pond expansion.

c) The pond will meet a theoretical detention time of 24 hours. It is equipped with a decant, a culvert principle spillway and an open-channel emergency spillway. Any discharge from the pond will be in accordance with the approved UPDES Permit.

d) The pond inlets will be protected from erosion, and the spillway will discharge into the main Crandall Canyon drainage.

e) The pond is temporary, and will be removed upon final reclamation of the property.

f) The pond expansion will be constructed according to the regulations and under supervision of a Registered, Professional Engineer.

g) *The pond volume has been increased at the request of the Forest Service to provide a greater level of protection for forest resources located down stream from the minesite. The enlarged pond capacity (3.572 acre ft.) is over-designed to handle the following storm events:*

Storm Event	*Pond Volume Required*	*Pond Capacity Provided*
10 yr./24 hr.	*2.06 acre ft.*	*173%*
100 yr./6 hr.	*1.93 acre ft.*	*185%*
50 yr./24 hr.	*3.53 acre ft.*	*101%*
100 yr./24 hr.	*4.51 acre ft.*	*79%*

DESIGN OF DRAINAGE CONTROL STRUCTURES FOR RECLAMATION

Reclamation Hydrology:

Tables:

Figures:

Reclamation Hydrology

4.1 General (Phase I)

During Phase I of reclamation, all disturbed area culverts and ditches will be removed except as shown on Plate 5-16. Undisturbed diversions UD-2 and UD-3 will also be removed, and the drainage from those areas will be directed to the sediment pond. Undisturbed diversion UD-1 will remain in place as a permanent structure for the following reasons:

(1) The diversion is necessary to continue to divert runoff from the reclaimed site, the U.S. Forest Service turnaround area and beneath the U.S. Forest Service Road;

(2) The 10 year-24 hour storm runoff from WSUD-1 is approximately 2.98 acre feet, which combined with runoff from the reclaimed site, exceeds the holding capacity of the sediment pond;

(3) The existing diversion is a 42" full-round C.M.P. pipe, which is well in excess of the size required to carry runoff from a 100 year-6 hour storm event for the area (See Table 10).

The main canyon 72" culvert will also be removed during Phase I reclamation, except for the lower approximately 300', which will be left in place to divert undisturbed and treated runoff beneath the sediment pond. Once the main canyon culvert is removed, Crandall Creek will be directed back to the original drainage channel through the area. Silt fences will be installed on both sides of the restored channel to treat runoff from the reclaimed pad areas, as shown on Plate 5-16.

The U.S. Forest Service Road will be left as a permanent feature. A berm and ditch (RD-1) will be established along the road. This ditch will direct all runoff from areas above the road to the sediment pond. The sediment pond will remain in place until Phase II of reclamation.

During Phase I reclamation, provisions will also be made to permanently handle the approximate 600 - 700 gallon per minute flow of mine water from the sealed north side portals. The flow is presently carried by a buried pipe from the portal area, beneath the road and dumped directly into a riser pipe to the main canyon culvert. Upon Phase I reclamation, the existing pipe will be replaced with a rip-rapped ditch down the steep slope, into an 18" diameter cmp culvert beneath the U.S. Forest Service Road, and again into a rip-rapped ditch to the reclaimed main channel. The ditch has been designated MD-1, and the culvert is designated MC-1, as shown on Plate 5-16 and 5-17. As indicated on Plate 5-16, culvert MC-1 will be extended beyond reclaimed ditch RD-1, allowing RD-1 to flow over the culvert without mixing the 2 flows at least until Phase II reclamation. At that time both flows will go directly to the reclaimed main channel as shown on Plate 5-17.

Ditch MD-1 and culvert MC-1 are therefore considered permanent features of the reclaimed mine site. These structures are sized to safely convey the maximum expected mine water discharge of 700 gpm (1.56 cfs), although the present discharge is considerably less (approx. 600 gpm). The proposed rip-rap size of 12" D_{50} will also provide more than adequate protection against erosion for the maximum expected flow. Rip-rap will be installed at a minimum depth of 1.5 D_{50} (18"), and placed on a bedding layer of -2" gravel to a depth of 0.75 D_{50} (9"), as shown on Figure 13.

Watersheds are shown on Plates 7-5 and 7-5C. Reclamation drainage details are shown on Plates 5-16 and 5-17.

4.2 General (Phase II)

Once the criteria for Phase II Bond Release are met, the sediment pond will be removed and, the area recontoured and reseeded according to the plan. The remaining 300' of the main canyon 72" culvert will also be removed at this time. At the discretion of the U.S. Forest Service, the berm along the road can also be removed at this time, or left in place. If the berm if left in place, reclaimed ditch RD-1 will be extended through the reclaimed pond area to the main channel. As indicated above, ditch MD-1 and culvert MC-1 will also remain, and flow to the reclaimed main channel.

4.3 Reclamation - Disturbed Drainage Control

Drainage from all contributing watersheds above the U.S. Forest Service Road, except WSUD-1, will be collected in a reclamation ditch (RD-1) and diverted into the sediment pond during Phase I reclamation. Drainage from the reclaimed areas and contributing watersheds below the road, will be treated through silt fences along the restored natural main channel, during Phase I reclamation.

Approximately 300' of the main canyon culvert will remain in place beneath the sediment pond area during Phase I.

Upon Phase II reclamation, the sediment pond will be removed and the area restored. The remaining portion of the main canyon culvert will also be removed at this time. Silt fences along the previously reclaimed channel section may also be removed during Phase II; however, additional silt fences will be installed along the 300' section of culvert removal channel restoration.

Undisturbed diversion UD-1, ditch MD-1 and culvert MC-1 will remain in place as permanent features, as mentioned previously.

4.4 Restored Channels

Upon final reclamation, the main canyon drainage will be returned to the natural channel. During construction, this channel is to be covered by filter fabric and an underdrain system. The culvert will then be placed over the protected channel. Upon removal of the culvert, filter fabric will also be removed, exposing the natural channel. Construction in this manner will have a temporary effect on the riparian vegetation; however, this can readily be restored upon reclamation. Flow characteristics, bedding and other natural features of the natural channel will not be changed appreciably; therefore, no actual channel reconstruction or reclamation (beyond revegetation) is proposed.

No other channels are proposed to be restored within the reclaimed minesite.

4.5 Sediment Pond

The sediment pond will remain in place during Phase I reclamation. The pond will be removed during Phase II and all drainage will be returned to the Main Crandall Canyon channel at that time.

Calculations show the sediment pond to be adequately sized to contain the runoff from contributing watersheds from a 10 year-24 hour precipitation event, along with a minimum of 3 years of sediment storage. The principle and emergency spillways are each capable of passing the runoff from a 25 year-6 hour event, as required.

4.6 Calculations

For ease of calculation and to ensure a conservative runoff requirement for sediment pond adequacy, no curve numbers for contributing watersheds were changed for reclamation purposes. Contributing watershed characteristics and flows were taken from Tables 1 through 4 of this report. Watersheds and pre-reclamation drainage control are shown on Plates 7-5 and 7-5C. Phase I and Phase II drainage control are shown on Plates 5-16 and 5-17, respectively.

TABLE 14

RECLAMATION - PHASE I
RUNOFF SUMMARY
DRAINAGE TO SEDIMENT POND

Watershed	10 year/24 hour Volume-ac.ft.	10 year/ 6 hour Peak Flow-cfs	25 year/6 hour Peak Flow-cfs
WSUD-2	0.05	0.04	0.08
WSUD-3	0.30	0.23	0.43
WSDD-1	0.03	0.05	0.07
WSDD-2	0.01	0.01	0.03
WSDD-3	0.09	0.26	0.37
WSDD-4	0.03	0.11	0.14
WSDD-5	0.07	0.23	0.32
WSDD-7	0.05	0.11	0.16
WSDD-8	0.23	0.41	0.62
WSDD-10	0.13	0.39	0.53
WSDD-11	0.09	0.10	0.18
WSDD-14	0.13	0.39	0.56
Totals	1.21	2.33	3.49

Note: *Volumes and flows are totals from respective watersheds on Tables 3 and 4 of this report.*

TABLE 15

RECLAMATION - PHASE I
RUNOFF CONTROL STRUCTURE
WATERSHED SUMMARY

Structure	Type	Contributing Watersheds
Main Channel	Silt Fence	WSDD-12, WSDD-13
UD-1	Culvert	WSUD-1
RD-1	Ditch	WSUD-2, WSUD-3, WSDD-1 thru WSDD-11
Sediment Pond	Pond	WSUD-2, WSUD-3, WSDD-1 thru WSDD-11 and WSDD-14
MD-1	Ditch	Mine Water Discharge
MC-1	Culvert	Mine Water Discharge

TABLE 16

RECLAMATION - PHASE I
RUNOFF CONTROL STRUCTURE
FLOW SUMMARY

Structure	Type	10 year/6 hour Peak Flow (cfs)	25 year/6 hour Peak Flow (cfs)	100 year/6 hour Peak Flow (cfs)
Main Channel	Silt Fence	3.73	5.44	-
UD-1	Culvert	1.91	3.68	6.81
RD-1	Ditch	1.94	2.93	-
Sediment Pond	Pond	2.33	3.49	-
*MD-1	Ditch	1.56	-	-
*MC-1	Culvert	1.56	-	-

* Continuous Mine Water Discharge

TABLE 17

RECLAMATION - PHASE 1
RECLAIMED DITCH/CULVERT DESIGN SUMMARY

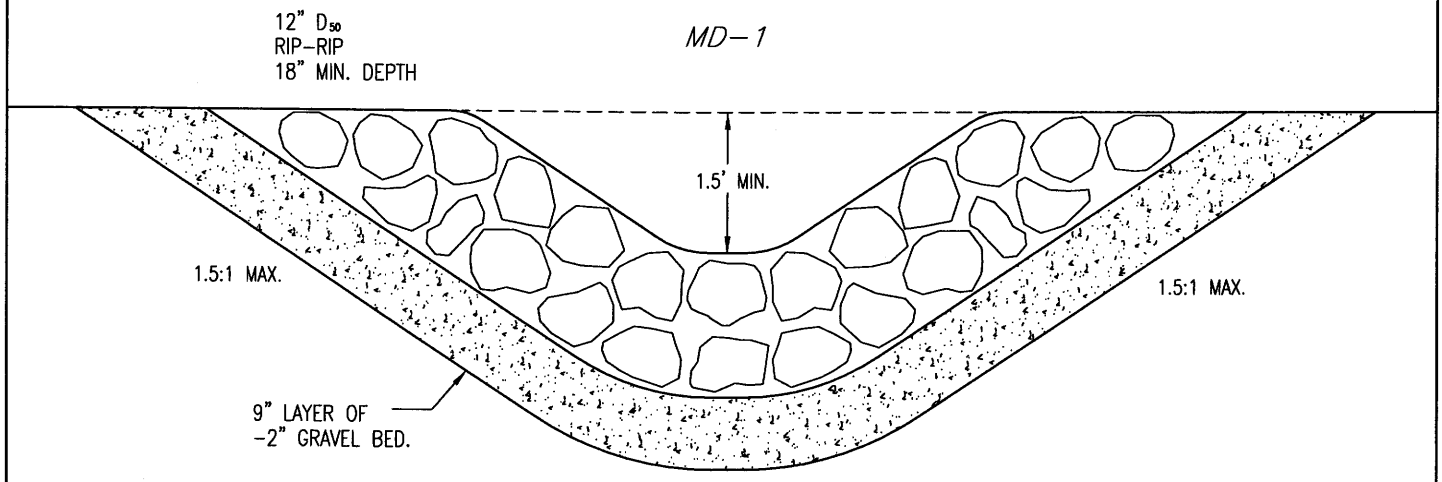
Ditch	RD-1	*MD-1	**MC-1
Slope (%)	10.10	75.00	3.00
Length (ft.)	990	210	60
Manning's No.	0.035	0.035	0.020
Side Slope (H:V)	1.5:1	1.5:1	-
Bottom Width (ft.)	0	0	1.50 Diam.
Peak Flow 10/6 (cfs)	1.94	1.56	1.56
Flow Depth (ft.)	0.52	0.33	0.70
Flow Area (ft^2)	0.40	0.16	0.39
Velocity (fps)	4.85	9.75	4.03
Lined (Y/N)	N	N	-
Rip Rap Req'd (Y/N)	N	Y	N
Rip Rap D_{50}	-	12"	-

Note: Slope / Length from Plate 5-16

* Mine Water Ditch to Reclaimed Main Channel.

** Mine Water Culver beneath U.S. Forest Service Road.

MINE WATER DISCHARGE
RECLAMATION DITCH MD–1
TYPICAL SECTION



DITCH SIZING		
DITCH	*FLOW DEPTH*	*FLOW AREA*
MD–1	*0.33*	*0.16*

NOTE:

DITCH CONFIGURATIONS MAY VARY IN FIELD; HOWEVER, MINIMUM FLOW DEPTHS AND AREAS WILL BE MAINTAINED.

FIGURE 13

Title of run: MD-1

Solving for	Depth Normal

Triangle

Flow depth (ft)	0.33
First Side slope	1.5
Second Side slope	1.5
Slope of diversion	0.7500
Manning"s n	0.035
CFS	1.56
Cross section area (sqft)	0.16
Hydrualic radius	0.14
fps	9.75
Froude number	4.66

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: GENWAL MINE

Comment: MINE WATER CULVERT MC-1

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0300 ft/ft
Manning's n.....	0.020
Discharge.....	1.56 cfs

Computed Results:

Full Flow Diameter.....	0.70 ft
Full Flow Depth.....	0.70 ft
Velocity.....	4.03 fps
Flow Area.....	0.39 sf
Critical Depth....	0.58 ft
Critical Slope....	0.0295 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	1.56 cfs
QMAX @.94D.....	1.68 cfs
Froude Number.....	FULL

PLATE 5-3

SURFACE FACILITY MAP

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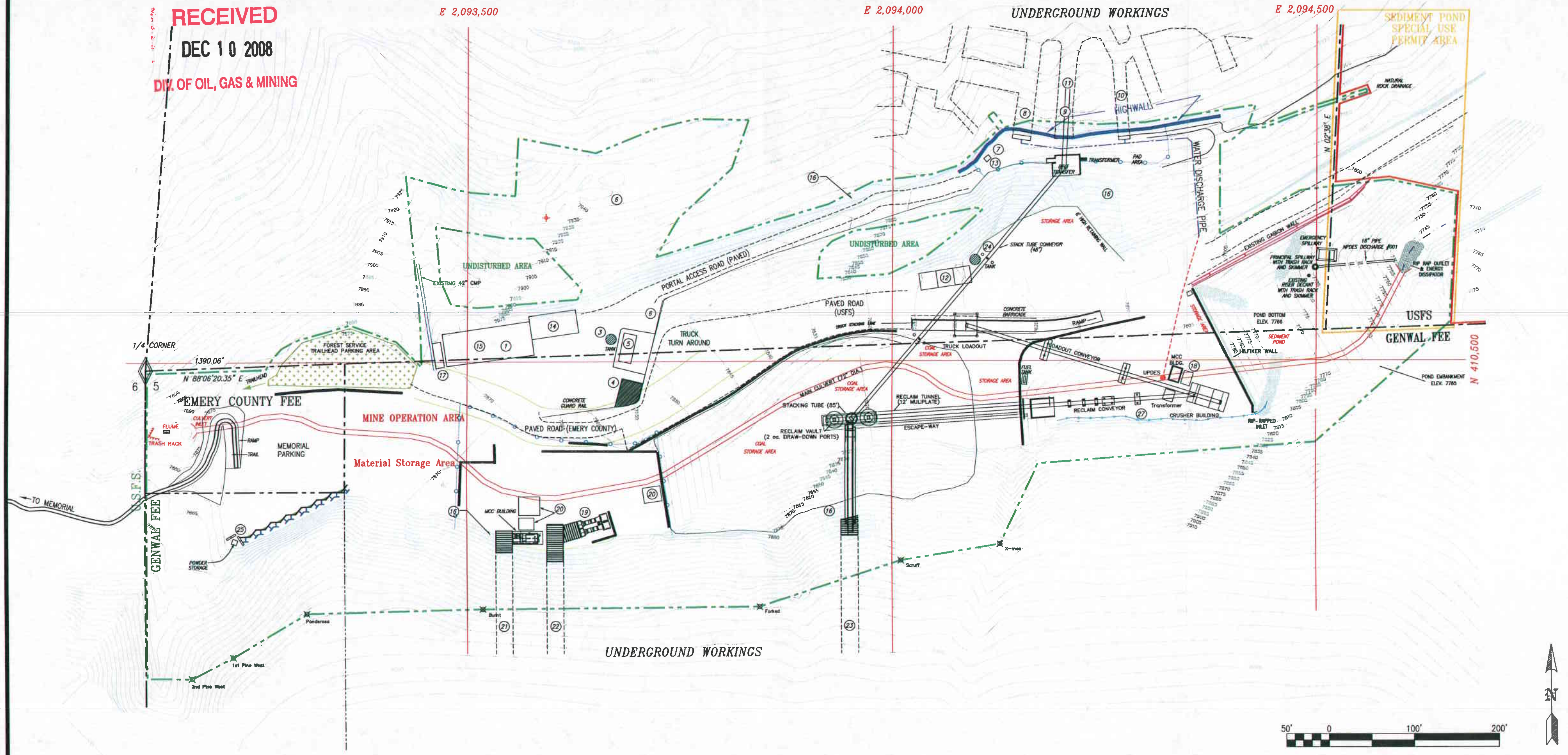

LEGEND:

- SEDIMENT POND (SPECIAL USE PERMIT AREA)
- EXTENT OF DISTURBANCE
- 10' CONTOUR
- JERSEY BARRIERS
- RE-ESTABLISHED USFS ROAD (DOUBLE-LANE) / / / /
- SAFETY BARRIERS
- FENCING

FACILITY LEGEND:

1. Shop
2. Ventilation Fan
3. Rockdust Silo
4. Concrete Dumpster Pad
5. Power Center
6. Power Pole
7. Offices & Bathhouse (u'grd)
8. Intake Portal
9. Belt Portal
10. Fan Portal
11. Mine Belt
12. Oil Storage
13. Visual Disconnect
14. New Warehouse and Office Building
15. 4500 Gallon Cullinary Water Tank
16. Shotcrete
17. Parts Shed
18. Portable Shed
19. Ventilation Fan
20. Material Storage Sheds
21. Intake Portal
22. Return Portal
23. Belt Portal
24. Mag Tank
25. Powder Storage
26. Cap Storage
27. Concrete Ditch

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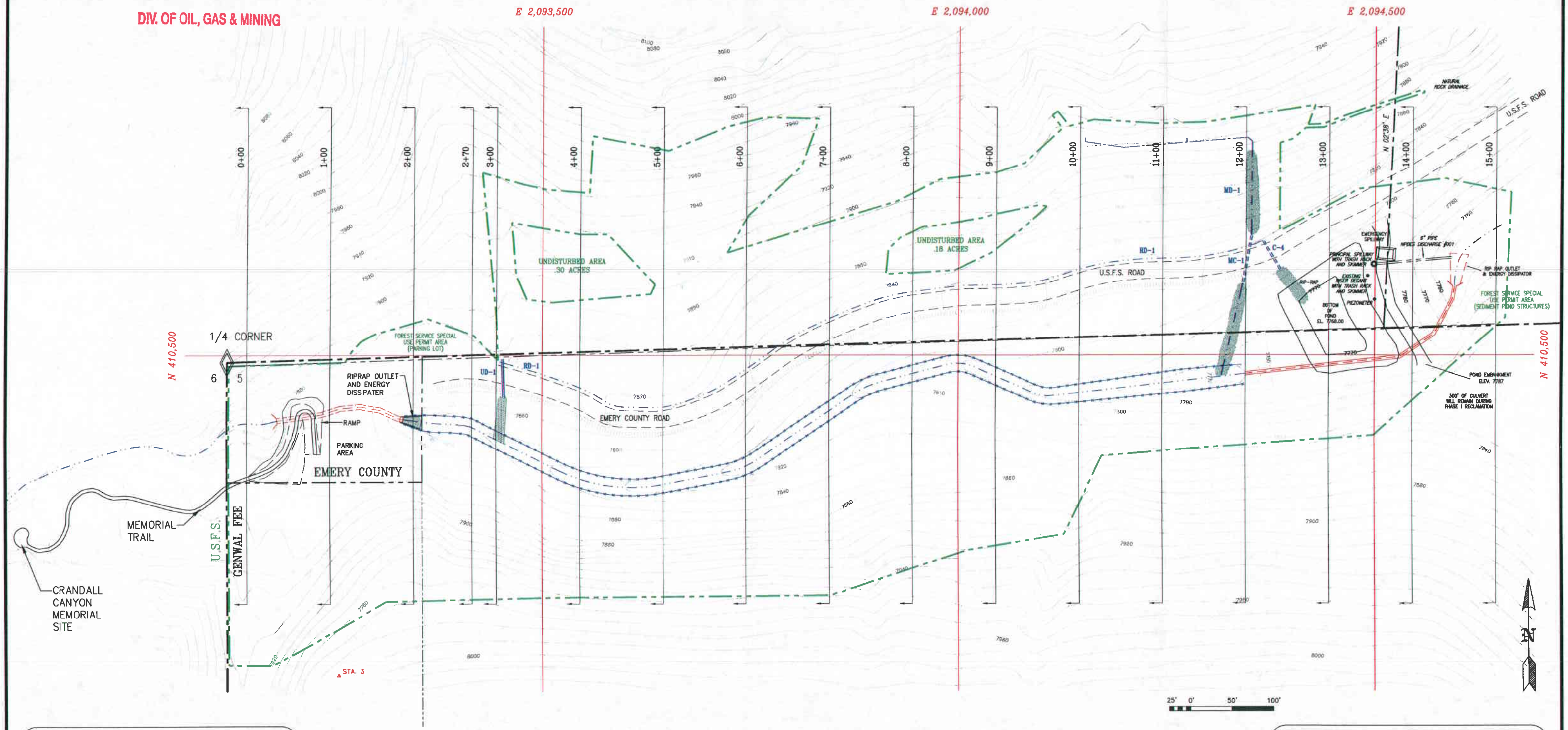
CRANDALL CANYON MINE SURFACE FACILITIES

REV: 16	ACAD: 5-3
DATE: 12/8/08	BY: PJJ
SCALE: AS SHOWN	PLATE #: 5-3

G:\Shared\Current Drawings\MRP Maps\Crandall Canyon\Current\Cranall Portal Reclamation\Plate 5-3 REV 16.dwg, 11x17, 12/8/2008 2:31:41 PM

PLATE 5-16

RECLAMATION (PHASE I)



LEGEND:

- EXTENT OF DISTURBANCE
- 10' CONTOUR
- CROSS-SECTION
- RECLAMATION DIVERSION DITCH — RD-1
- BERM
- ALTERNATE SEDIMENT CONTROL
- 6' ø CULVERT

CONTOUR INTERVAL = 10'
PHOTOGRAPHY DATE = OCTOBER 25, 1989

NOTE:

1) SEDIMENT POND WILL STAY IN PLACE DURING PHASE I RECLAMATION.

2) STREAM BED WILL BE RETURNED AS IT PRESENTLY EXISTS BELOW MEMORIAL PARKING AREA.

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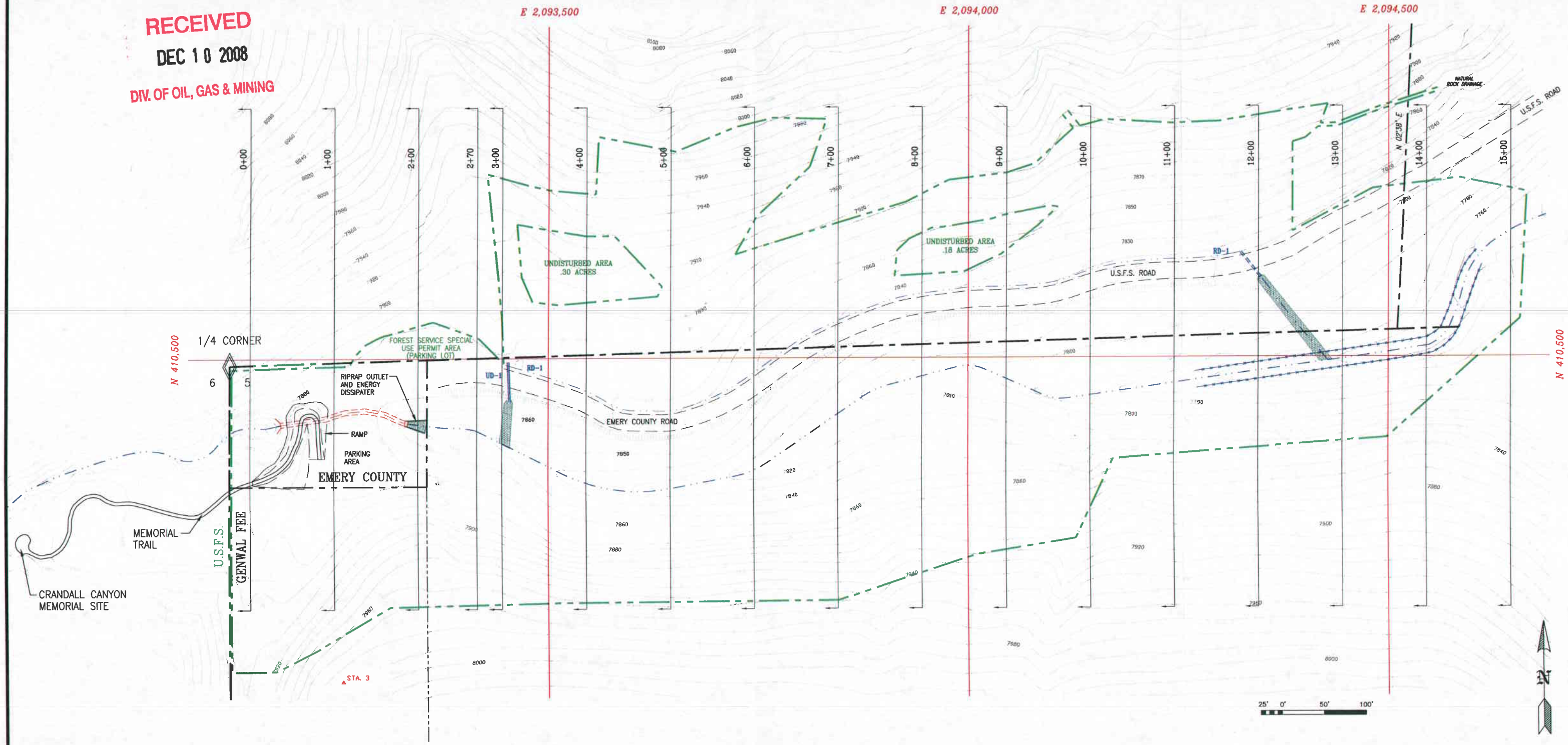
CRANDALL CANYON MINE RECLAMATION (PHASE I)

DRAWN BY:	PJJ	REVISION NUMBER:	8
DATE:	12/08/08	PLATE #:	5-16
SCALE:	AS SHOWN		

G:\Shared\Current Drawings\WRP Maps\Crandall Canyon\Current\Cranall Portal Reclamation\ACAD-PLATE 5-16 REV 8.dwg, 11X17, 12/8/2008 2:33:03 PM

PLATE 5-17

RECLAMATION (PHASE II)



LEGEND:

- EXTENT OF DISTURBANCE
- 10' CONTOUR
- CROSS-SECTION
- RECLAMATION DIVERSION DITCH — RD-1
- BERM
- ALTERNATE SEDIMENT CONTROL
- 6' Ø CULVERT

CONTOUR INTERVAL = 10'
PHOTOGRAPHY DATE = OCTOBER 25, 1989

NOTE:
1) STREAM BED WILL BE RETURNED AS IT PRESENTLY EXISTS BELOW MEMORIAL PARKING AREA.

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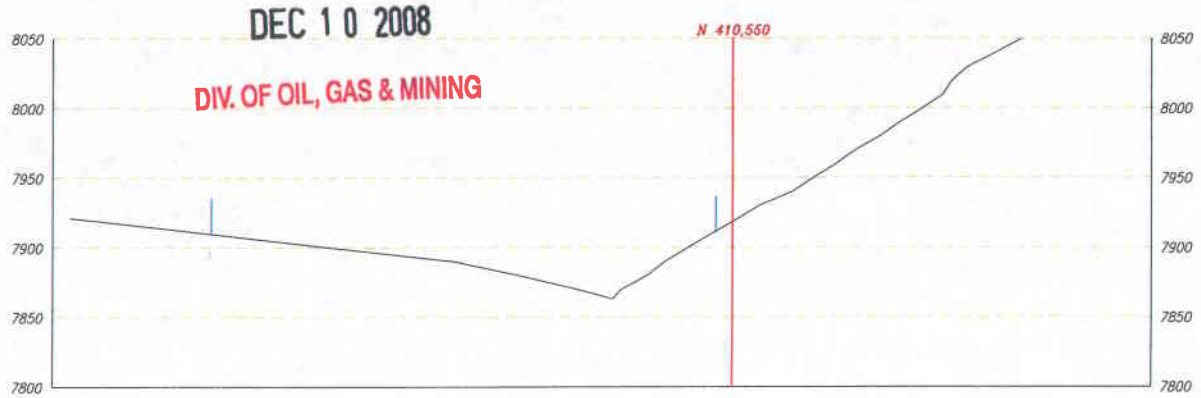
CRANDALL CANYON MINE RECLAMATION (PHASE II)

DRAWN BY:	PJJ	REVISION NUMBER:	8
DATE:	12/08/08	PLATE #:	5-17
SCALE:	AS SHOWN		

PLATE 5-17A

RECLAMATION CROSS-SECTIONS



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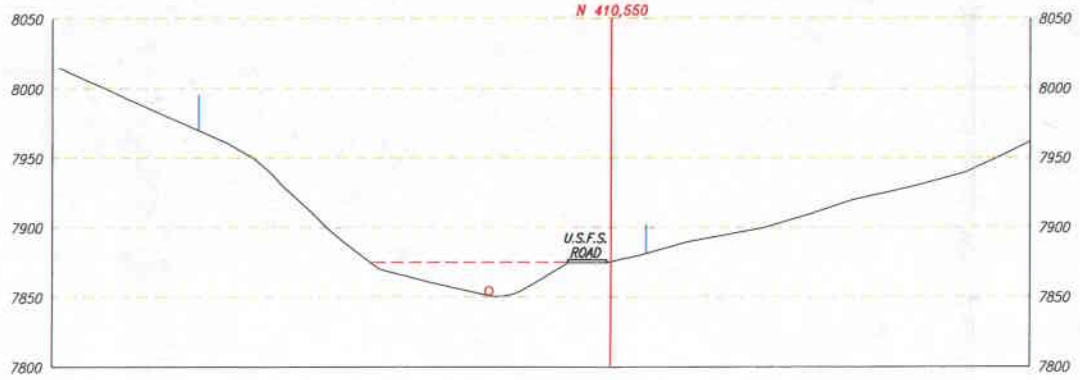


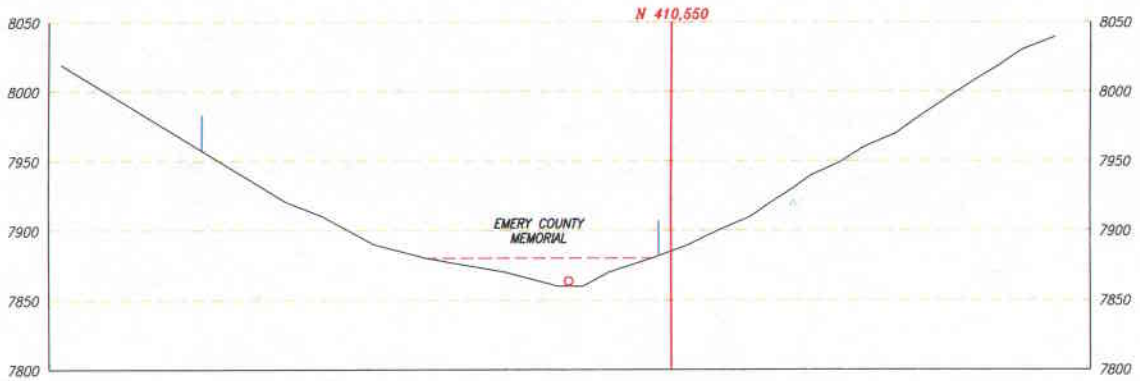
2+70

LEGEND:

- EXISTING GROUND LINE
- PROPOSED GROUND LINE
- RECLAMATION LINE
- EXTENT OF DISTURBANCE

NOTES:

1) CROSS-SECTION LOCATIONS ARE SHOWN ON PLATES 5-16 AND 5-17.
2) STREAM BED IS BASED ON ACTUAL SURVEY.
3) SEDIMENT POND WILL REMAIN IN PLACE THROUGH PHASE 1 RECLAMATION.



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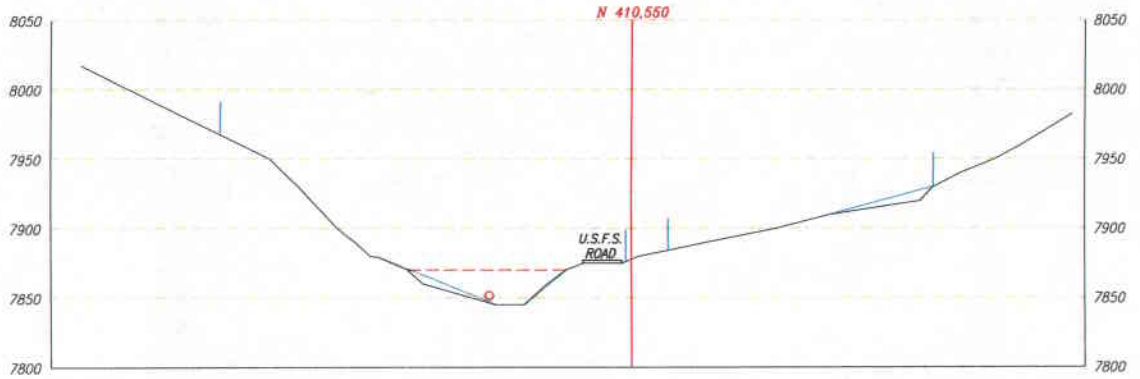
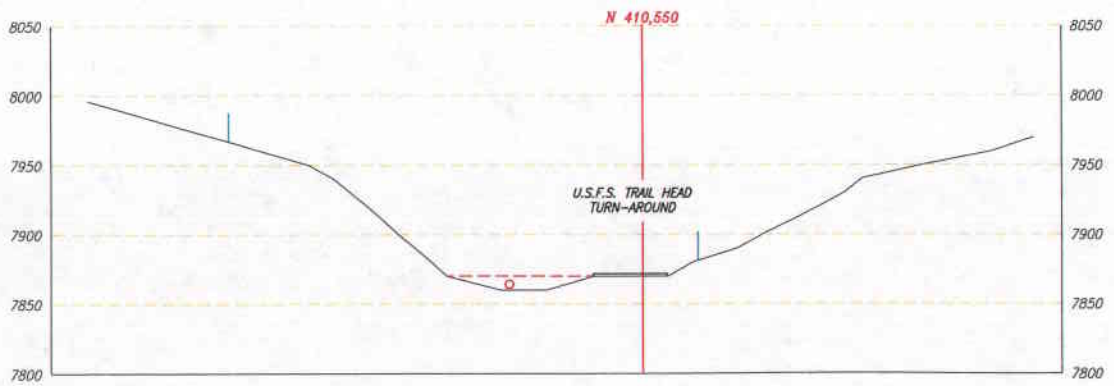


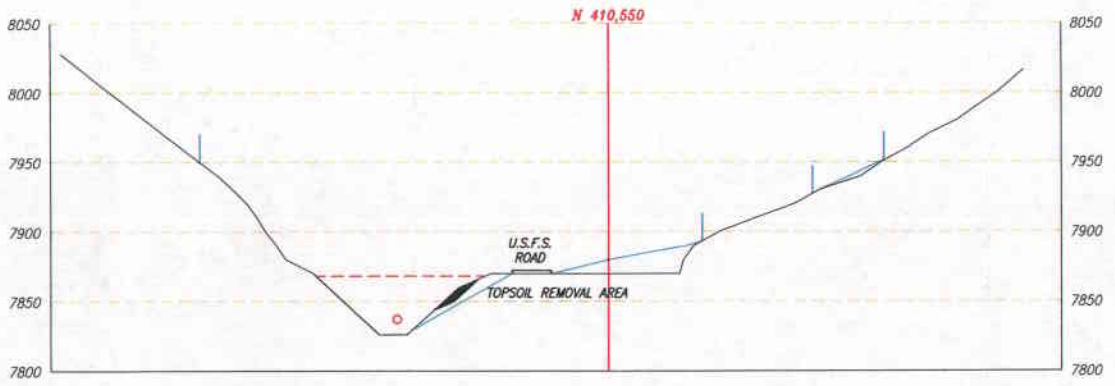
3+00

SCALE:

50' 0' 100' 200'



2+00



4+00

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CRANDALL CANYON MINE RECLAMATION CROSS-SECTIONS

DRAWN BY:	PJJ	REVISION NUMBER:	5
DATE:	12-08-08	PLATE #:	5-17A
SCALE:	AS SHOWN		