# APPLICATION FOR COAL PERMIT PROCESSING
## Detailed Schedule Of Changes to the Mining And Reclamation Plan

**Permittee:** Alton Coal Development, LLC
**Mine:** Coal Hollow Mine
**Permit Number:** C/025/0005
**Title:** Pit 10 to Pond 3 Pipeline, Pond 1 and Facilities update Task ID 4967

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

| Add | Replace | Remove | DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED |
|---|---|---|---|
| ☐ | ☒ | ☐ | Chapter 5, Pages 5-36, 5-37, 5-38, 5-54, 5-57 and 5-72 |
| ☐ | ☒ | ☐ | Chapter 5, Appendix 5-2 |
| ☒ | ☐ | ☐ | Chapter 5, Appendix 5-13 |
| ☐ | ☒ | ☐ | Chapter 5, Drawings 5-3, 5-3A, 5-8C, 5-28, and 5-30 |
| ☐ | ☒ | ☐ | Chapter 7, Pages 7-65, 7-66, 7-74, 7-75, and 7-77 |
| ☐ | ☒ | ☐ | Chapter 7, Appendix 7-15 |
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| Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan. | Received by Oil, Gas & Mining |
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| | |

system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment. Details for this structure can be viewed on Drawings 5-3, 5-8, and 5-8A.

- Oil and Fuel Containments: The oil and fuel containments will be concrete structures appropriately sized for containing metal tanks. The oil containment will contain 55 gallon barrels and up to 2,000 gallon totes. This containment will be 80 feet long by 30 feet wide and 3 feet deep. The fuel containment will store 3 fuel tanks. Included will be a 4,000 gallon unleaded fuel tank and three 12,000 gallon diesel tanks. This structure will 50 feet long by 30 feet wide and 3 feet deep. Details for this structure can be viewed on Drawings 5-3 and 5-8.
- Coal Stacking System: The coal stacking system will be located in the central part of the facilities area. This system will include a coal hopper, coal feeder breaker, feed conveyor, crusher, and an inclined conveyor belt. Trucks will dump coal into the coal hopper which will funnel coal through the feeder breaker onto a short feed conveyor belt. This conveyor belt will transport the coal approximately 195 feet to a crusher that will size the coal appropriately for market. Once the coal is sized through the crusher it will enter an inclined stacker conveyor belt that is angled at approximately 16 degrees and is 186 feet long. This system will be a radial conveyor which will feed a coal stock pile with a live storage of approximately 50,000 tons. This system can be viewed on Drawings 5-3 through 5-5.
- Coal Loadout System: The coal loadout system will be located in the central part of the facilities area. This system will include an above ground reclaim feeder, a coal reclaim conveyor and an inclined conveyor. The reclaim feeder will be loaded by a dozer pushing the coal onto the feeder. One inclined conveyor that is approximately 290 feet in length will convey the coal from the feeder to the loadout hopper. This loadout hopper will load highway approved haul trucks that transport coal to market.
- Minor Facilities: The minor facilities will include a septic vault at the office (Drawing 5-6), a power washing and water recycle system in the Wash Bay (Drawing 5-8A), conduit with electrical lines running from generators to various facilities (Drawing 5-8B), Water System (Drawing 5-8C), an Equipment Hotstart Area (Drawing 5-3, 5-8B) and a Field Hydrant (Drawing 5-4, 5-5, 5-8B).
- Electrical System: The electrical system for the facilities at Coal Hollow will consist of two diesel fuel powered generators. One generator is a 750 KVA unit that will provide electricity to all the buildings. The other generator is a 1200 KVA unit that will be used to supply electricity to the coal conveying, sizing, stockpiling and loading system. The anticipated layout of the electrical system is shown on Drawing 5-8B.
- Dust Control Structures: A water system will be constructed to provide water for non-potable uses at the facilities and also for fugitive dust control measures. This system will consist of a water well, 6" water transport pipe, and two 16,000 gallon water tanks. These two tanks are located at the facilities area to provide a water supply to the facilities for non-potable uses (cleaning equipment, restrooms, etc...) and to load the water truck which will spray water on the active roads for dust control. The pipe line connecting the tanks to the well will be buried, the tanks are a portable unit with its own elevated base, no other base is required. A third tank is located east of the underground portals in Pit 10 and will supply water for dust

control underground and other non-potable uses. The pipe line connecting the tank to the well will be above ground, this tank is also a portable unit with its own elevated base, no other base is required. Further details related to this water system can be viewed on Drawing 5-8C.

- Underground Mining Facilities: Mine fan, portable generator/power supply, water supply system (described above) and stacking conveyor. The generator and stacker are mobile and considered temporary. The mine fan is a single unit that is mounted, but easily removed. All of these facilities are in an existing pit, and shown on Drawing 5-3B.

During mine development and the initial mining period, some facilities of a temporary nature such as mobile buildings and crusher/stacking conveyors may be utilized.

Support facilities to provide lighting at night will be kept to a minimum but will need to be sufficient enough to provide safe operating conditions in the dark. The following lighting equipment is anticipated to be used to provide safe working conditions:

- Two to three mobile light plants: Each light plant will have up to four 1,000 watt lights.
- Four to six exterior lights at the facilities area for lighting walkways and miscellaneous work areas: Each of these is expected to be 250 watt lights.
- Lights on mobile mining equipment, support vehicles and building lights

The support facilities will be located, maintained, and used in a manner that prevent or control erosion and siltation, water pollution, and damage to public or private property; and to the extent possible use the best technology currently available to minimize damage to fish, wildlife, and related environmental values; and minimize additional contributions of suspended solids to stream flow or runoff outside the mine permit area. Any such contributions will not be in excess of limitations of Utah or Federal law.

The facilities will be fully reclaimed at the end of mining operations with the exception of the water well. The final contour for this area can be viewed on Drawing 5-35 and 5-37 and an anticipated timetable is shown on Drawing 5-38.

526.300 Water Pollution Control Facilities:

Water pollution associated with mining and reclamation activities within the permit areas will be controlled by:

- Construction of berms and/or diversion ditches to control runoff from all facilities areas.
- Roads will be constructed with ditches to capture runoff
- Diversion ditches will be constructed as necessary around active mining and reclamation areas to capture runoff from those areas.
- Sedimentation impoundments will be constructed to control discharges

- In areas where impoundments or diversions are not suitable to the surrounding terrain, silt fence or other appropriate structures will be utilized to control sediment discharge from the permit area.

In order to accomplish these objectives, watershed analysis of the permit and adjacent areas has been completed and specific designs are established for each water pollution control structure. Primary control structures include five sediment impoundments, four diversion ditches and miscellaneous berms. The locations of these structures can be viewed on Drawing 5-3. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-25 through 5-34. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-1. The watershed and structure sizing analysis can be viewed in Appendix 5-2. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13.

In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

All these facilities will be reclaimed to approximate original contour. The reclamation sequence and final landform can be viewed on Drawings 5-35 and 5-38.

526.400 Air Pollution Control Facilities:

Air pollution (fugitive dust) emissions from mining and reclamation operations in the permit area will be controlled by a number of means, including:

- Haul roads will be maintained and will have water or other dust suppressants applied as appropriate.
- Road surfaces will be graded to stabilize/remove dust-forming debris as required.
- Areas adjoining primary roads will be stabilized and vegetated as required.
- Mobile equipment speeds will be controlled to minimize dusting conditions.
- Cleared vegetation debris within the mine area will be disposed of by placement in pit backfills.

A water system will be constructed to provide water for non-potable uses at the facilities and also for fugitive dust control measures. This system will consist of a water well, 6" water transport pipe, and two 16,000 gallon water tanks. The first water tank will be placed near the mining area and will be used specifically to load the water truck which will spray water on the active roads within the permit area to control dust. The second tank is located at the facilities area to provide a water supply to the facilities for non-potable uses (cleaning equipment, restrooms, etc…). Further details related to this water system can be viewed on Drawing 5-8C.

For details related to air pollution control and monitoring, refer to Chapter 4 and Appendix 4-2 and 4-5.

## 530 OPERATIONAL DESIGN CRITERIA AND PLANS:

### 531 GENERAL:

There are five sediment impoundments proposed for the permit area. These structures will be constructed using a combination of dozers and backhoes. The structures have been designed to contain the required storm events as specified in Appendix 5-2. The structures will have sediment removed as necessary to ensure the required capacities. Details for these structures can be viewed on Drawings 5-25, 5-26 and 5-28 through 5-32. Calculations and supporting text can be viewed in Appendix 5-2.

There are no other coal processing waste banks, dams or embankments proposed within the permit area.

Underground mining has not occurred within the permit area.

### 532 SEDIMENT CONTROL:

Four diversion ditches along with five sediment impoundments are proposed for the permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13.

Mulch will be placed on the seedbed surface once soil amendments have been incorporated and seeding has been accomplished in areas that will be reclaimed to native plant communities. The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Like the seeding methods, mulch will be applied with a variety of techniques and materials depending on the reclaimed area.

#### 532.100 Disturbed Area:

The smallest practicable area, consistent with reasonable and safe mine operational practices will be disturbed at any one time during the mining operation and reclamation phases. This will be accomplished through progressive backfilling, grading, and prompt revegetation of disturbed areas. An estimated reclamation schedule is shown on Drawing 5-38 or.

#### 532.200 Backfill Stabilization:



The backfilled material will be stabilized by grading to promote a reduction of the rate and volume of runoff in accordance with the applicable requirements. The excess spoil and fill above approximate original contour will be graded to a maximum angle 3h:1v slope and revegetated to minimize erosion. This area is designed with concave slopes

- *Be prepared by, or under the direction of, and certified by a qualified, registered, professional engineer, except that all coal processing waste dams and embankments covered by R645-301-536 and R645-301- 746.200 shall be certified by a qualified, registered, professional engineer;*

  Designs for the proposed impoundments have been prepared by a qualified, registered, professional engineer, with assistance from a geotechnical expert. These certifications can be viewed on Drawings 5-28 through 5-31.

- *Include any design and construction requirements for the structure, including any required geotechnical information;*

  A geotechnical analysis of the impoundments has been prepared by an expert in this field. This analysis can be viewed in Appendix 5-1. Embankments will be constructed in 2 foot lifts as recommended by the analysis.

- *Describe the operation and maintenance requirements for each structure; and*

  The proposed impoundments are designed to temporarily store water from storm events and snow melt. Long term standing water in the impoundments is anticipated to be seasonal and sediment will be removed as necessary to provide the required storage capacities. Emergency spillways have been included in the designs to provide a non-destructive discharge route should the capacities ever be exceeded. Surveys of these impoundments will be regularly conducted to ensure that design capacities are available. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13.

- *Describe the timetable and plans to remove each structure, if appropriate.*

  All impoundments will be reclaimed at the end of operations. The estimated timeline for removal of these structures are shown on Drawing 5-38. Expected removal is year seven of the mining and reclamation process. In areas where soils are not stabilized following the removal of these sediment impoundments, silt fence will be appropriately installed and maintained to provide sediment control until stable conditions are met.

Detailed designs of impoundments can be viewed on Drawings 5-28 through 5-31. Locations can be viewed on Drawing 5-3 and 5-25.

542.740. Disposal of Noncoal Mine Wastes.

Noncoal mine waste including, but not limited to grease, lubricants, paints, flammable liquids, garbage, abandoned mining machinery, lumber and other combustible materials generated during mining activities will be placed and temporarily stored in a controlled manner in a designated portion of the permit area and hauled offsite to a state approved recycling or solid waste disposal site. Final disposal of noncoal mine waste will not take place within the permit area. With the exception of removal of perforated piping used in the construction of Alluvial Ground Water Drains that will be left in place as mining advances and water line piping. This perforated piping will be covered in place approximately 20' to 30' below the final reclaimed surface. All other waste materials (ie. metal culvert) associated with the Alluvial Ground Water Drains will be removed and disposed of in a State-approved solid waste disposal site. The buried water line from the well to the Coal Yard and the Buried water line from the well to the tank East of Pit 10 will be cut off 4' below the final surface, capped and left in place.

542.800. Reclamation Cost.

The amount of the bond will depend upon the requirements of the ***approved*** permit and reclamation plan (R645-830.120).

A preliminary estimate of reclamation costs is included in Appendix 8-1. This estimate is based upon the proposed plan of open pit, highwall and underground mining. A final bond estimate will be provided by the applicant to the Division upon completion of the approved permit and reclamation plan.

## 550. RECLAMATION DESIGN CRITERIA AND PLANS

## 551. SEALING AND CASING OF UNDERGROUND OPENINGS

When no longer required, underground mine openings will be closed in accordance with R645-301-513, R645-301-529, R645-301-551 and MSHA approved requirements and backfilled. When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.



If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

# APPENDIX 5-2

Sediment Impoundment and
Diversion Structure Analysis

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# Coal Hollow Mine – Sedimentation Structure Sizing

## Introduction

Protection of surface water quality at the Coal Hollow Mine is an important part of the mining process. By utilizing sedimentation structures for diversion and sediment impoundment, Alton Coal Development, LLC (ACD) will minimize the sediment that could potentially flow from active disturbance areas into drainages that are in and surrounding the proposed project area. Appropriate sizing of these structures is a necessary step toward ensuring that these controls function properly and serve the purpose of protecting the surrounding environment.

Therefore, ACD has completed a watershed analysis for appropriate sizing of four proposed sedimentation impoundments and four diversion ditches. This report will outline the methods used and results of this analysis.

# Sediment Impoundments

## Summary

The watersheds for the four proposed sedimentation impoundments have been evaluated mainly using the TR-55 method. This method of analysis was first issued by the Soil Conservation Service (SCS) in 1975. It has since been revised and updated numerous times. This method is applicable for evaluating small watersheds.

To assist with the calculations and mapping, Carlson 2007 Hydrology software has been utilized for this evaluation. A watershed analysis for this project includes: runoff flow paths, watershed boundaries, length and average grade for longest flow lines, runoff curve number classification, time of concentration and peak discharge. Information from this analysis was then used for sedimentation structure sizing. For the specifics associated with each of these parameters refer to the details section of this report.

The sedimentation structures were sized to impound the runoff associated with a 100-year frequency, 24-hour duration storm event. Using the Carlson rainfall map (assembled using TP-40 and TP-47 data), the rainfall intensity associated with this size of event for the Alton area is 3.1 inches. The following table summarizes the final results for each sedimentation structure:

| **Sedimentation Impoundment Capacities** | | | | |
|---|---|---|---|---|
| Structure | Storage Required (ac/ft) | Design Storage* (ac/ft) | Percent above requirement | Additional Storage (ac/ft) |
| 1 | 2.6 | 3.2 | 123 | 0.6 |
| 2 | 1.7 | 2.3 | 135 | 0.6 |
| 3 | 6.3 | 12.6 | 200 | 6.3 |
| 4 | 3.8 | 5.5 | 224 | 1.7 |

| | | | | |
|---|---|---|---|---|
| 1B | 0.5 | 0.8 | 160 | 0.3 |

*Design capacities include a minimum of 2 feet free board (spillway to top of embankment)

Based on the NOAA Atlas 14, Vol. 1, Version 5, "Point Precipitation Frequency, Alton, Utah", the 10-year / 24-hour precipitation for this area is 2.39". The required runoff from the 10-year / 24-hour event for Sediment Pond 3 was calculated using the Office of Surface Mining "Storm Program, 6.20", by Gary E. McIntosh. Using the watershed parameters from this appendix, the required storage for a 10-year / 24-hour storm event from the No. 3 Watershed (to Sediment Pond 3) is 4.95 acre feet.

A 4" HDPE drainage pipe will be installed from the underground mining sump to the inlet end of Pond 3. This pipe is expected to carry up to 100 gpm or 0.22 cfs. A 6" decant pipe has been installed in Pond 3, which will allow controlled decanting of the water in the event of a continuous mine water discharge. The pond can be decanted to an elevation of 6808, which is 3 feet below the spillway. At this elevation, the pond can still contain approximately 4.98 ac. ft. of runoff, which is slightly greater than the 4.95 ac. ft. of runoff from a 10-year / 24-hour event of 2.39"; therefore, the pond will still meet the requirement of treating a 10-year / 24-hour runoff event. (See Drawing 5-30 for pond and volume details.)

The enclosed maps and cross sections detail the design and location for each structure (Drawings 5-25 through 5-34). These drawings also show proposed spillways, diversion ditches and watersheds associated with each structure.

## Details

Determining storage capacity requirements using the TR-55 method requires several steps. This section of the report will provide the details and assumptions associated with each step. These steps are: watershed boundaries/flow paths, runoff curve number classification, time of concentration, peak discharge and structure sizing.

- **Watershed Boundaries/Flow Paths**
  The watershed boundaries were determined by first identifying the runoff flow paths for the entire project area. This was completed by creating a three dimensional model of the surface topography. This model was then used to draw flow paths for all the watersheds. Based on these flow paths, boundaries for each watershed are easily determined based on flow direction in combination with proposed control structures (ponds, diversion ditches, etc..).

  Using this process, the project area (in conjunction with diversion ditch locations and berms) was found to be separated into seven distinct watersheds. The natural separations of watersheds in this area are Lower Robinson Creek to the north and Sink Valley Wash at the south end. In addition to these natural separations, the proposed diversion ditches and berms also provide definite boundaries as shown on Drawings 5-26 and 5-27. The following summarizes the watersheds:

| Sediment Impoundment Watersheds | | |
|---|---|---|
| Watershed | Area (acres) | Description |
| 1 | 27 | North end of project area where facilities are proposed. |
| 2 | 74 | Borders south edge of Lower Robinson Creek. |
| 3 | 285 | Main watershed through the center of permit area |
| 4 | 96 | Southern most watershed bordered by Sink Valley Wash |
| *5 | 28 | Isolated area between watersheds 3 and 4 |
| *6 | 19 | Area northwest of Lower Robinson Creek Reconstruction |
| 7 | 5 | Southwest end of facilities area, entrance/exit road |

* These watersheds will have silt fence or other appropriate control measures installed.

- **Rainfall Amount and Runoff Curve Number Classification**
  First data required to begin estimating runoff for the watersheds is the rainfall amount and the runoff curve number classification. The rainfall amount is the precipitation associated with a 100 year frequency, 24 hour duration storm event. The runoff curve number classification is a classification of the soil and vegetation cover conditions for the watersheds.

  In order to estimate runoff from rainfall, the rainfall amount for a 100 year frequency, 24 hour duration storm event was determined using the Carlson rainfall map. This map was assembled by Carlson software based on TP-40 and TP-47 data. The resulting rainfall amount for the Alton area using this map is 3.1 inches.

  The runoff curve number was determined by matching the ground cover description and estimated hydrologic soil group for the project area to the descriptions available in Table 2-2d of TR-55. Based on visual observations of the project area and soils the following classifications were estimated:

  1. Cover Description: The cover description that best fits watersheds 2, 3 and 4 is "Sagebrush with grass understory". The hydrologic condition for this cover was estimated at "fair" which is defined as 30% to 70% ground cover. This estimation was based off the knowledge of current conditions and future disturbance/reclamation. Plans for this operation include sequenced disturbance combined with concurrent reclamation. This will minimize the area that will be disturbed at any one time. This will be combined with a general vegetation coverage improvement within one to two growing seasons for reclamation compared to current conditions. In addition, a significant amount of runoff from the active mining area for this magnitude of storm

event will be temporarily controlled within the active pit area and will not immediately report to the designed impoundments.

Watershed 1 and 7 have been classified differently since they includes the mine facilities area. This watershed is classified as "Gravel roads" since most the area will be stripped of vegetation and gravel spread for parking areas and roads. This results in a much higher runoff than the classification for the other three watersheds.

2. Hydrologic Soil Group: This classification was estimated to be Group C for the five watersheds evaluated, as outlined in Appendix A in TR-55. This classification is for soils having low infiltration rates thus producing high amounts of runoff. The soils in this classification typically have infiltration rates of 0.05 to 0.15 inches per hour.

The resulting curve number for watersheds 2, 3 and 4 is 63. Watershed 1 and 7 were assigned a curve number of 89. These classifications are intended to be conservative estimates (producing higher than expected runoff) to ensure that the sedimentation structures have more than sufficient storage capacity.

These classifications are used in the next step for determining the time of concentration.

- **Time of Concentration ($T_c$)**
  $T_c$ is the time for runoff to travel from the furthest point in the watershed to the point that it meets the sedimentation structure. This figure is essential for calculating the peak flow which is used to determine the required size for the sedimentation structure. The SCS method for calculating $T_c$ is used in this analysis. The following table summarizes the inputs for calculating the $T_c$ along with the resulting outputs:

| **Time of Concentration ($T_c$)** | | | | |
|---|---|---|---|---|
| Watershed | Curve Number | Flow Length (ft) | Average Slope (%) | $T_c$ (hrs) |
| 1 | 89 | 1,087 | 6.8 | 0.16 |
| 2 | 63 | 5,670 | 3.8 | 1.7 |
| 3 | 63 | 7,095 | 3.5 | 2.2 |
| 4 | 63 | 3,805 | 2.9 | 1.8 |
| 7 | 89 | 750 | 3.9 | 0.08 |
| *3 | 63 | 7,095 | 3.5 | 1.5 |

*Based on 10-year / 24-hour precipitation event of 2.39".

The $T_c$ for each watershed is used to calculate the peak discharge which is the final step leading to the structure sizing.

- **Peak Discharge**
  The peak discharge for each watershed was calculated using the Graphical method. The inputs required for this method include: $T_c$, drainage area, 100 year 24 hour rainfall and the runoff curve number (CN). The following table outlines these inputs and the peak discharge:

| Peak Discharge (**Inflow) | | | | | |
|---|---|---|---|---|---|
| Watershed | CN | Tc (hr) | Rainfall (in) | Drainage Area (ac) | Peak Discharge (cfs) |
| 1 | 89 | 0.16 | 3.1 | 27 | 74.7 |
| 2 | 63 | 1.7 | 3.1 | 74 | 9.9 |
| 3 | 63 | 2.2 | 3.1 | 285 | 31.8 |
| 4 | 63 | 1.8 | 3.1 | 96 | 14.8 |
| 7 | 89 | 0.8 | 3.1 | 5 | 15.6 |
| *3 | 63 | 1.5 | 2.4 | 285 | 11.4 |

* Based on 10-year / 24-hour precipitation event of 2.39".

** The peak discharge from each watershed will also be the peak inflow to the sedimentation structures.

- **Sedimentation Impoundment Sizing**
  The method used for this step is again from the TR-55 program. A sedimentation structure is required for each one of the five watersheds analyzed. Therefore, a size has been evaluated for the five proposed structures. The inputs for this calculation are the following: drainage area, peak inflow, desired outflow, and runoff depth (Q). The desired outflow in this situation is zero since we do not intend any discharge from the structures. The spillways for these structures are proposed for emergency use only and are not intended for regular discharges. The following table summarizes these inputs and the required storage capacity for each watershed:

| Sedimentation Impoundment Sizing | | | | |
|---|---|---|---|---|
| Watershed | Drainage Area (ac) | Inflow (cfs) | Q (in) | Storage Required (ac/ft) |
| 1 | 27 | 74.7 | 2.00 | 2.6 |
| 2 | 74 | 9.9 | 0.48 | 1.7 |
| 3 | 285 | 31.8 | 0.48 | 6.3 |
| 4 | 96 | 14.8 | 0.48 | 3.8 |
| 1B | 5 | 15.6 | 2.00 | 0.5 |
| *3 | 285 | 11.4 | 0.208 | 4.95 |

*Based on 10-year / 24-hour precipitation event of 2.39".

The enclosed maps show the proposed design and locations for each one these structures.

## Conclusions

This analysis provides estimates of sufficient storage capacities for each watershed to impound water from a 100 year frequency, 24 hour duration storm event at the proposed

Coal Hollow Mine. In addition to the required storage capacities, a minimum 15% additional storage capacity has been added to each structure design to account for sediment and any standing water that may occur. Spillways have also been included in the structure designs to provide a non-destructive route for discharge should these capacities ever be exceeded.

The one exception to the above is Pond 3. Although the pond size is 200% greater than required for the 100-year / 24-hour event, the pond may also receive water pumped from the underground mine. If a continuous discharge from the mine should occur, the pond is equipped with a decant which would allow for a static level 3' below the spillway. At this elevation, the pond would still have a retention capacity of 4.98 ac. ft., which is slightly greater than the 4.95 ac. ft. calculated runoff from a 10-year / 24 hour event.

Due to the isolated characteristics and the inability to effectively divert water from Watershed 5 and 6, the method of using silt fence or other appropriate control measures for sediment have been chosen and is included on the Drawing 5-26.

The structure designs established from this analysis will minimize impacts from sediment to the surrounding environment at the Coal Hollow Mine.

# Diversion Ditches

## Summary

The channel sizing for the four proposed diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 100 year, 24 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. Similar to the impoundment sizing, the Carlson Software Hydrology module was utilized to perform these calculations. The ditch locations, designs and cross sections can be viewed on Drawings 5-33 and 5-34.

The following table summarizes the inputs and results for each diversion based on flows during a 100 year, 24 hour storm event:

| Diversion Ditch Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ditch | *Base (ft) | Manning's n | Average Slope (%) | Peak Flow (cfs) | Flow Depth (ft) | Velocity (fps) | Freeboard (ft) |
| 1 | 3.0 | 0.020 | 2.8 | 17.4 | 0.6 | 7.2 | 0.3 |
| 2 | 2.5 | 0.020 | 3.5 | 6.9 | 0.4 | 6.0 | 0.3 |
| 3 | 4.5 | 0.020 | 2.4 | 16.7 | 0.5 | 6.3 | 0.3 |
| 4 | 5.0 | 0.020 | 1.1 | 19.8 | 0.6 | 5.4 | 0.3 |

*All side slopes are 2h:1v

## Details

- **Watersheds**
  The first step used for evaluating the diversions was to determine the peak flow during a 100 year, 24 hour storm event for each diversion. In order to determine this variable, the TR-55 method of watershed analysis was again utilized. This requires determining the watershed boundaries associated with each diversion. The following table summarizes these watersheds:

| Diversion Watersheds | | |
|---|---|---|
| **Ditch** | **Area (acres)** | **Description** |
| 1 | 158 | Diverts water around project area |
| 2 | 48 | Diverts water along Robinson Creek to Pond 2 |
| 3 | 72 | Diverts water around facilities area |
| 4 | 169 | Diverts water from project area into Pond 3 |

- **Rainfall Amount and Runoff Curve Number Classification**
  The rainfall amount for a 100 year, 24 hour storm event was developed utilizing the same method as previously discussed in the impoundments section of this report. This number is 3.1 inches of precipitation.

  The runoff curve number classification for all four watersheds was estimated to be 63. This classification is consistent with the classification and logic used for the impoundment analysis.

- **Time of Concentration ($T_c$)**
  $T_c$ is the time for runoff to travel from the furthest point in the watershed to the point that it meets the sedimentation structure. This figure is essential for calculating the peak flow which is used to determine the required size for the diversion ditch. The SCS method for calculating $T_c$ is used in this analysis. The following table summarizes the inputs for calculating the $T_c$ along with the resulting outputs:

| Time of Concentration ($T_c$) | | | | |
|---|---|---|---|---|
| Ditch | Curve Number | Flow Length (ft) | Average Slope (%) | $T_c$ (hrs) |
| 1 | 63 | 8,487 | 2.9 | 2.9 |
| 2 | 63 | 4,187 | 3.6 | 1.4 |
| 3 | 63 | 3,742 | 13.7 | 0.7 |
| 4 | 63 | 5,868 | 3.9 | 1.8 |

  The $T_c$ for each watershed is used to calculate the peak flow which is the final step leading to the diversion dimensions.

- **Peak Flow**

The peak flow for each diversion was calculated using the Graphical method. The inputs required for this method include: $T_c$, drainage area, 100 year 24 hour rainfall and the runoff curve number (CN). The following table outlines these inputs and the peak flow:

| **Diversion Peak Flow** | | | | | |
|---|---|---|---|---|---|
| Ditch | CN | Tc (hr) | Rainfall (in) | Drainage Area (ac) | Peak Flow (cfs) |
| 1 | 63 | 2.9 | 3.1 | 158 | 17.4 |
| 2 | 63 | 1.4 | 3.1 | 48 | 6.9 |
| 3 | 63 | 0.7 | 3.1 | 72 | 16.7 |
| 4 | 63 | 1.8 | 3.1 | 169 | 19.8 |

- **Diversion Dimensions**
  The Manning's Equation (ME) equation was used to appropriately size the each diversion. Inputs into this equation are manning's coefficient, average diversion slope, peak flow and side slope angles. Outputs are the depth of flow, and base dimension for a trapezoidal channel design. The following table summarizes the inputs and results:

| Diversion Ditch Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ditch | **Base (ft) | *Manning n | Average Slope (%) | Peak Flow (cfs) | Flow Depth (ft) | Velocity (fps) | Freeboard (ft) |
| 1 | 3.0 | 0.020 | 2.8 | 17.4 | 0.6 | 7.2 | 0.3 |
| 2 | 2.5 | 0.020 | 3.5 | 6.9 | 0.4 | 6.0 | 0.3 |
| 3 | 4.5 | 0.020 | 2.4 | 16.7 | 0.5 | 6.3 | 0.3 |
| 4 | 5.0 | 0.020 | 1.1 | 19.8 | 0.6 | 5.0 | 0.3 |

*Manning n of 0.020 is for ordinary firm loam
**All side slopes are 2h:1v

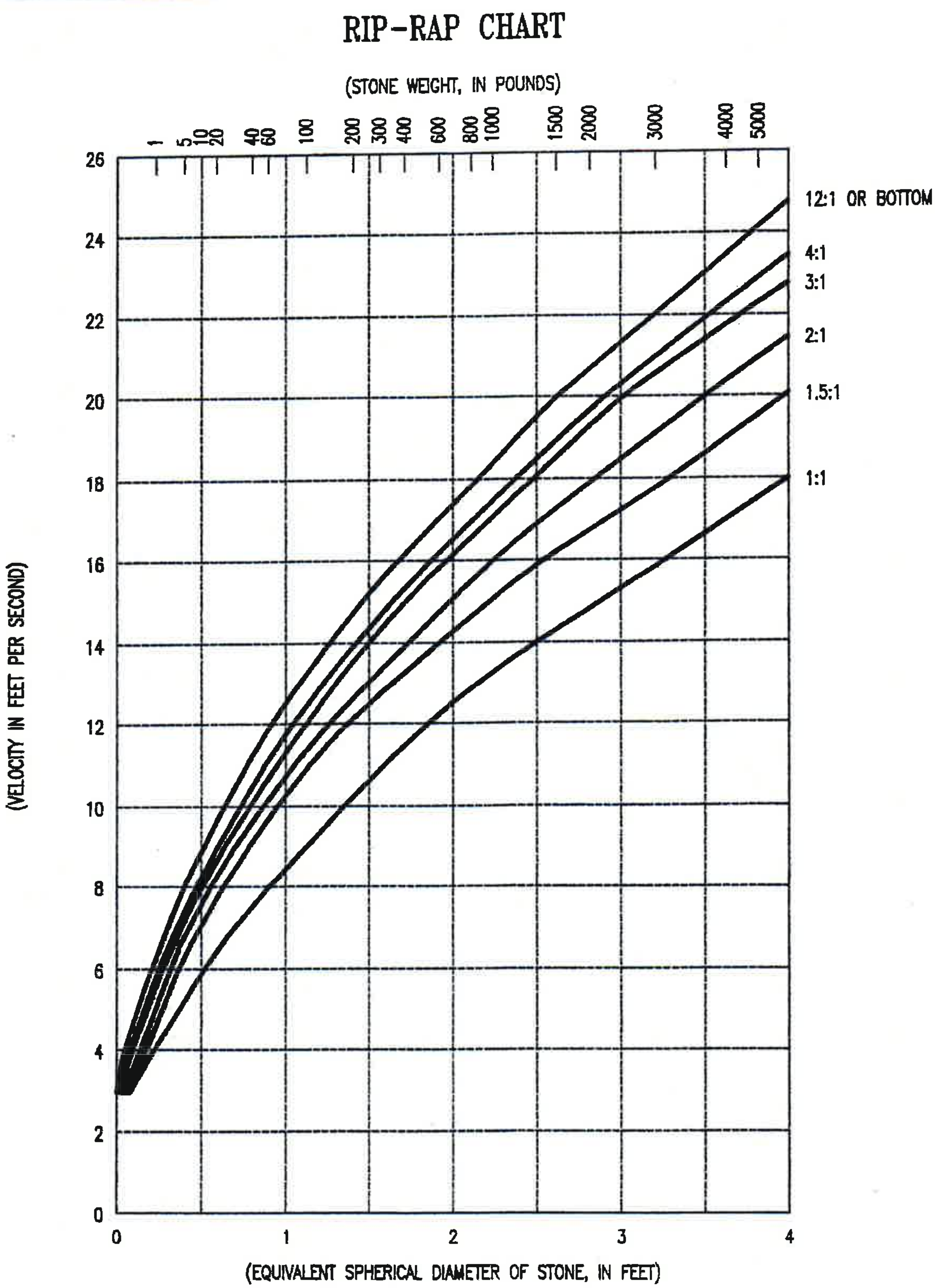
It should be noted that ditch 4 steepens as it drops into Pond 3. The inlet area is protected from erosion by installation of 9" D50 rip-rap as shown on Drawing 5-30. The flow velocity is calculated based on the following criteria:

Base Width = 5.0'
Manning's n = 0.035
Avg. Slope = 8.0%
Side Slopes = 2H:1V
Peak Flow = 19.8 cfs

When these parameters are applied to the OSM Storm 6.20 Program for General Channel Design, the calculated flow velocity is 6.67 fps at a depth of 0.50 ft.. The attached Rip-Rap Chart (Figure 1) shows a 9" D50 rip-rap is adequate to control erosion at the calculated flow velocity.

## Conclusions

These diversions have been sized in manner that will transport the necessary flows and minimize erosion during a 100 year, 24 hour storm event. These diversions will prevent runoff from up gradient watersheds from entering the active mining areas and will also assist in directing water from disturbed areas to the sediment impoundments.




**SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES**

NOTE:

ADAPTED FROM REPORT OF SUBCOMMITTE ON SLOPE PROTECTION, AM. SOC. CIVIL ENGINEERS PROC. JUNE 1948.
FOR STONE WEIGHING 165 LBS. PER CUBIC FEET.



Figure 1

# APPENDIX 5-13

**EVALUATION OF PIPELINE**

**FROM**

**PIT 10 TO SEDIMENT POND 3**

# EVALUATION OF PIPELINE

# FROM

# PIT 10 TO SEDIMENT POND 3

## ALTON COAL DEVELOPMENT, LLC

## COAL HOLLOW MINE

UTAH REGISTERED PROFESSIONAL ENGINEER
#154168
DAN W. GUY
11/17/15


**By**

**Dan W. Guy**

**Registered Professional Engineer**

**State of Utah No. 154168**

## EVALUATION OF PIPELINE FROM PIT 10 TO SEDIMENT POND 3

### General

It is proposed to install a 4" High Density Polyethylene (HDPE) drainage pipe from the sump in Pit 10 to Sediment Pond 3. The pipe will provide a means to pump collected runoff or seepage from Pit 10, as well as a contingency to safely discharge any excess water if encountered in the underground mining.

### Plan

The plan is to collect water in a sump with dimensions of approximately 14' in diameter by 14' deep. The sump pump is to be automatically activated as the sump fills, and to shut off when the water depth is at 6'. The water will be pumped into the 4" line, which will run up the western highwall of Pit 10 and then be buried from the haulroad to Pond 3, as shown on the attached Figure 1 – Plan View. The line is projected to be approximately 3250' in length and will discharge at the uppermost end of Pond 3, as shown. The sump is also shown on the attached Figure 1 – Plan View.

The proposed rate of the pumped discharge is 100 gpm or 0.22 cfs. At this rate, the exit velocity of the pumped water is expected to be less than 5 fps and non-erosive; however, it is proposed to diffuse the pipe discharge over a 5' wide by 10' long apron of 9" D50 or larger rock underlain by erosion control fabric to prevent any scouring.

### Sediment Pond Sizing

As shown in Appendix 5-2, Sediment Pond 3 has a required volume of 6.30 ac. ft. to contain the runoff and sediment from a 100 yr. – 24 hr. precipitation event. The actual size of the pond is 12.60 ac. ft., leaving an excess capacity of 6.30 ac. ft. over the required volume. Although it is very unlikely, if the proposed sump pump were to discharge continuously for 24 hours at 100 gpm, that would amount to approximately 0.44 ac. ft. added to the pond. The large size of the pond would still allow for complete retention of the pumped water and design runoff from a 100 yr. – 24 hr. storm for far greater than 24 hours. In the event the continuous discharge were to occur over a long period of time, the water could be discharged through the decant when it reached an elevation of 6808, or 3' below the spillway. At this elevation, the pond would still have a retention capacity of 4.98 ac. ft., which is adequate to contain the calculated 4.95 ac. ft. runoff from a 10-year / 24-hour storm. The decant would discharge onto the existing pond spillway, which is underlain by erosion control fabric and rip-rapped.

**Settling / Discharge Quality**

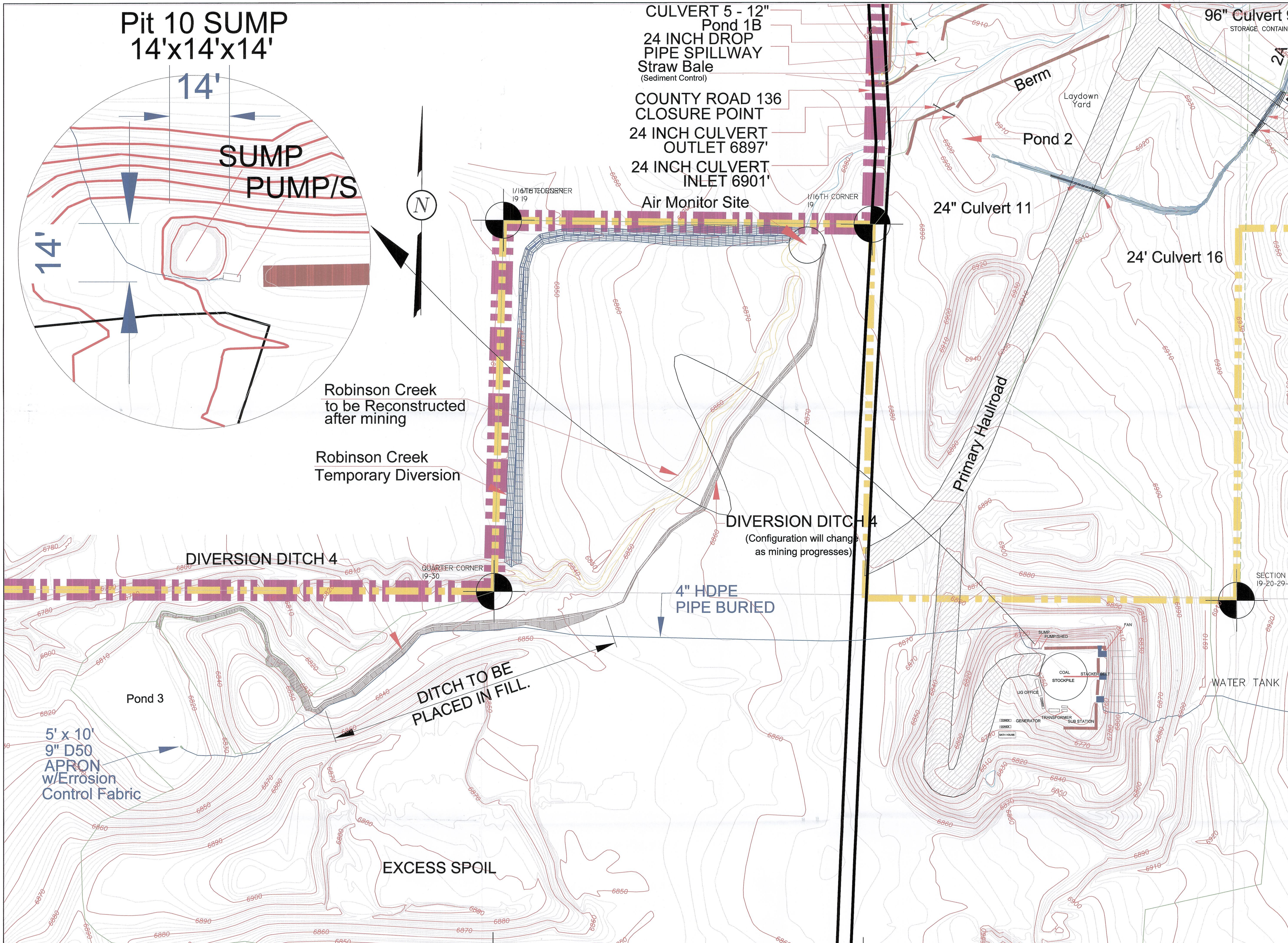
As indicated above, the pond is of adequate size to contain the maximum pumped volume and design storm runoff for more than 24 hours to provide adequate time for settling of sediments. In fact, it would provide for a much longer time (up to 14 days) if required, prior to reaching the spillway.

In the unlikely event that water would need to be pumped from the underground operations, this would be far cleaner than storm or surface water, and would require little, if any, retention time to meet discharge standards.

The pond is also equipped with a 6" decant pipe, which will allow the operator to retain water as long as necessary to maximize settling, and then discharge under controlled conditions as described above. Any discharges from the pond will be in accordance with the approved UPDES Discharge Permit, and sampled as required.

**Conclusion**

The existing Sediment Pond 3 is adequately sized to provide complete retention of the pumped water and the design 100 yr. - 24 hr. storm event for greater than 24 hours, and as much as 342 hours (14+ days) to allow for settling of sediments. In addition, the pond can be drained down as needed under controlled conditions with the approved decant pipe system. All discharges would be in accordance with the approved UPDES Discharge Permit and sampled as required. Under the worst condition of a continuous mine discharge which would fill the pond, the water level would be maintained at the decant elevation of 6808, which is 3' below the spillway and would still provide for a storage capacity adequate to contain the runoff from a 10-year / 24-hour precipitation event.




Alton Coal Development
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**FACILITIES & STRUCTURES**

Pipline from Pit 10 to Pond 3

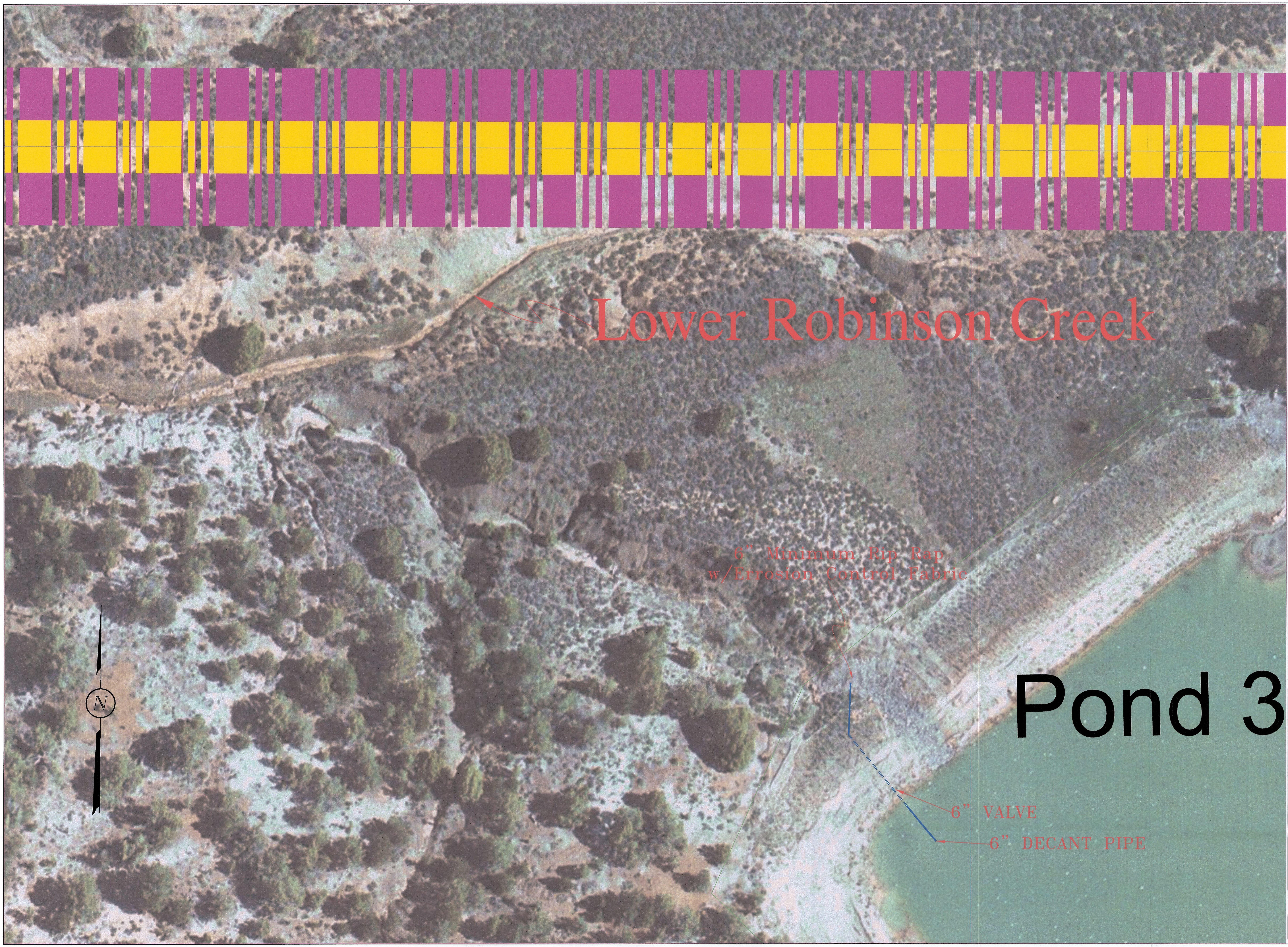
COAL HOLLOW PROJECT
ALTON, UTAH

**FIGURE 1**

| REVISIONS | |
|---|---|
| DATE: | BY: |
| 09/28/15 | KN |

| | |
|---|---|
| DRAWN BY: K. Nicholes | CHECKED BY: DWG |
| DRAWING: Figure 1 | DATE: 11/10/08 |
| | SCALE: 1" = 150' |
| JOB NUMBER: | SHEET |

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- COAL RECOVERY LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER
- PIPE LINE





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UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY 11/17/15

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June 2015 Aerial Down Stream of Pond 3

COAL HOLLOW PROJECT
ALTON, UTAH

FIGURE 2

| REVISIONS | |
|---|---|
| DATE: | BY: |
| 09/30/15 | KN |

| | |
|---|---|
| DRAWN BY: K. Nicholes | CHECKED BY: DWG |
| DRAWING: Figure 2 | DATE: 11/10/08 |
| | SCALE: 1" = 20' |
| JOB NUMBER: | SHEET |

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- COAL RECOVERY LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER
- PIPE LINE

| Sedimentation Impoundment Capacities | | | | |
|---|---|---|---|---|
| Structure | Storage Required (ac/ft) | Design Storage* (ac/ft) | Percent of requirement | Additional Storage (ac/ft) |
| 1 | 2.6 | 3.2 | 123 | 0.6 |
| 2 | 1.7 | 2.3 | 135 | 0.6 |
| 3 | 6.3 | 12.6 | 200 | 6.3 |
| 4 | 2.1 | 5.5 | 261 | 3.4 |
| 1B | 0.5 | 0.8 | 160 | 0.3 |

Structure 1 is a rectangular impoundment approximately 127.6feet long by 82 feet wide and 9 feet in depth. This impoundment will control storm water run off from the facilities area. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 3 feet freeboard. This pond will control storm water from a watershed of approximately 27 acres. The cleanout and spillway elevation are 6911' and 6920', respectively. The top of the embankment is at elevation 6924'. Details for the design can be viewed on Drawing 5-28.

Structure 1B is a small rectangular impoundment that is approximately 40 feet long by 20 feet wide. This impoundment will control storm water run off from the facilities access road system. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2 feet freeboard. This pond will control storm water from a watershed of approximately 5 acres. The cleanout and spillway elevation are 6894' and 6906', respectively. The top of the embankment is at elevation 6908'. Details for the design can be viewed on Drawing 5-28B.

Structure 2 is a rectangular impoundment approximately 188 feet long by 36 feet wide and 9 feet in depth. This impoundment will control storm water runoff from the disturbed areas immediately south of Lower Robinson Creek. The impoundment will be constructed with a 24" drop pipe spillway. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum 3 feet freeboard. This pond will control storm water runoff from a watershed of approximately 74 acres. The cleanout and spillway elevation are 6891' and 6900', respectively. Top of the embankment is at elevation 6903'. Details for the design can be viewed on Drawing 5-29.

Structure 3 is a valley fill impoundment that will impound an area approximately 472 feet long by 229 feet wide and 9 feet deep. The fill for the impoundment will be constructed from an excavation 378 feet wide by 229 feet long and 8 feet deep. The embankment will be constructed in 2 foot lifts utilizing a dozer. The top of the embankment will be a minimum 12 feet wide. This pond will have a decant pipe install at the 6808' elevation that allows for the pond level to be managed and to still be able to contain the 10 year 24 hour event. Also, this pond has a secondary open channel spillway that will have rip-rap min. 6" underlain with erosion control fabric. This pond will control storm water runoff from a watershed of approximately 300 acres, it will also be capable of receiving ground water from the underground in the event it cannot be managed at the underground operation (not considered likely). The cleanout and spillway elevation are 6801' and 6811', respectively. Top of the embankment is at 6813'. Details for the design can be viewed on Drawing 5-30.

Structure 4 is a rectangular pond located at the south end of the permit area that is approximately 90 feet wide by 582 feet long and 12 feet deep. This impoundment will be incised into the existing ground. Part of the excavation will be used to construct a 12 foot wide embankment. The spillway will be an open channel that will have rip-rap min. 6". This pond will control storm water runoff from a watershed of approximately 96 acres. The cleanout and spillway elevation are 6822' and 6834', respectively. Top of the embankment is at elevation 6838'. Details for the design can be viewed on Drawing 5-31.

Open channel spillway details for impoundments 3 and 4 are provided in Drawing 5-32. These spillways are designed for emergencies and are not expected to be used during normal operations.

The outer slopes of the impoundments will be sloped to a maximum grade of 3h:1v. Inside slopes will be graded to a maximum 2h:1v. The slopes will be graded and revegetated for erosion control.

No underground mine workings exist near or under the impoundment structures; therefore subsidence surveys are not provided.

Geologic data for the area where impoundments will be located consists of mainly fine grained alluvium with high clay content. Seepage from the impoundments is expected to be minimal based on the high clay content of the existing materials. Characterization of the soils is contained in Chapter 2. Acid and Toxic analysis of the soils indicates that water seeping through the alluvium layer will not result in reducing water quality. The acid and toxic analysis for the alluvium can be viewed in Appendix 6-2.

Hydrologic data for the permit area is provided in Appendix 7-1. This data indicates that there will be some seepage through the subsurface that may travel to adjacent drainages. The quantities for this seepage are expected to be minimal and will have minimal impact to the overall hydrologic balance. Even though seepage may occur, analysis of the soils indicates that water quality will not be diminished.

The above information provides a summary of all the impoundment structures that are proposed for the Coal Hollow Project. Detailed designs and calculations are provided in this section, Drawings 5-26 through 5-32 and Appendix 5-2. No other impoundments are anticipated.

| Sedimentation Impoundment Capacities | | | | |
|---|---|---|---|---|
| Structure | Storage Required (ac/ft) | Design Storage* (ac/ft) | Percent of requirement | Additional Storage (ac/ft) |
| 1 | 2.6 | 3.2 | 123 | 0.6 |
| 2 | 1.7 | 2.3 | 135 | 0.6 |
| 3 | 6.3 | 12.6 | 200 | 6.3 |
| 4 | 2.1 | 5.5 | 261 | 3.4 |
| 1B | 0.5 | 0.8 | 160 | 0.3 |

Structure 1 is a rectangular impoundment approximately 127.6 feet long by 82 feet wide and 9 feet in depth. This impoundment will control storm water run off from the facilities area. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 4 feet freeboard. This pond will control storm water from a watershed of approximately 27 acres. The cleanout and spillway elevation are 6911' and 6920', respectively. The top of the embankment is at elevation 6924'. Details for the design can be viewed on Drawing 5-28.

Structure 1B is a small rectangular impoundment that is approximately 40 feet long by 20 feet wide. This impoundment will control storm water run off from the facilities access road system. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2 feet freeboard. This pond will control storm water from a watershed of approximately 5 acres. The cleanout and spillway elevation are 6894' and 6906', respectively. The top of the embankment is at elevation 6908'. Details for the design can be viewed on Drawing 5-28B.

Structure 2 is a rectangular impoundment approximately 188 feet long by 36 feet wide and 9 feet in depth. This impoundment will control storm water runoff from the disturbed areas immediately south of Lower Robinson Creek. The impoundment will be constructed with a 24" drop pipe spillway. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum 3 feet freeboard. This pond will control storm water runoff from a watershed of approximately 74 acres. The cleanout and spillway elevation are 6891' and 6900', respectively. Top of the embankment is at elevation 6903'. Details for the design can be viewed on Drawing 5-29.

Structure 3 is a valley fill impoundment that will impound an area approximately 484 feet long by 229 feet wide and 9 feet deep. The fill for the impoundment will be constructed from an excavation 198 feet wide by 229 feet long and 8 feet deep. The embankment will be constructed in 2 foot lifts utilizing a dozer. The top of the embankment will be a minimum 12 feet wide. This pond will have a decant pipe install at the 6808' elevation that allows for the pond level to be managed and to still be able to contain the 10 year 24 hour event. Also, this pond has a secondary open channel spillway that will have rip-rap min. 6 underlain with erosion control fabric. This pond will control storm water runoff from a watershed of approximately 300 acres, it will also be capable of receiving ground water from the underground in the event it cannot be managed at the underground operation (not considered likely). The cleanout and spillway elevation are 6801' and 6810', respectively. Top of the embankment is at 6814'. Details for the design can be viewed on Drawing 5-30.

Structure 4 is a rectangular pond located at the south end of the permit area that is approximately 90 feet wide by 582 feet long and 12 feet deep. This impoundment will be incised into the existing ground. Part of the excavation will be used to construct a 12 foot wide embankment. The spillway will be an open channel that will have rip-rap min. 6. This pond will control storm water runoff from a watershed of approximately 96 acres. The cleanout and spillway elevation are 6822' and 6834', respectively. Top of the embankment is at elevation 6838'. Details for the design can be viewed on Drawing 5-31.

Open channel spillway details for impoundments 3 and 4 are provided in Drawing 5-32. These spillways are designed for emergencies and are not expected to be used during normal operations.

The outer slopes of the impoundments will be sloped to a maximum grade of 3h:1v. Inside slopes will be graded to a maximum 2h:1v. The slopes will be graded and revegetated for erosion control.

No underground mine workings exist near or under the impoundment structures; therefore subsidence surveys are not provided.

Geologic data for the area where impoundments will be located consists of mainly fine grained alluvium with high clay content. Seepage from the impoundments is expected to be minimal based on the high clay content of the existing materials. Characterization of the soils is contained in Chapter 2. Acid and Toxic analysis of the soils indicates that water seeping through the alluvium layer will not result in reducing water quality. The acid and toxic analysis for the alluvium can be viewed in Appendix 6-2.

Hydrologic data for the permit area is provided in Appendix 7-1. This data indicates that there will be some seepage through the subsurface that may travel to adjacent drainages. The quantities for this seepage are expected to be minimal and will have minimal impact to the overall hydrologic balance. Even though seepage may occur, analysis of the soils indicates that water quality will not be diminished.

Sedimentation ponds have been designed in compliance with the requirements of R645-301-356.300, R645-301-356.400, R645-301-513.200, R645-301-742.200 through R645-301-742.240, and R645-301-763.

No sedimentation ponds or earthen structures that will remain open are planned.

742.210 General Requirements

Additional contributions of suspended solids and sediment to streamflow or runoff outside the permit area will be prevented to the extent possible using the best technology currently available. Siltation structures for an area will be constructed before beginning any coal mining and reclamation operations in that area and, upon construction, will be certified by a qualified registered professional engineer to be constructed as designed and as approved in the reclamation plan. Any siltation structures which impounds water will be designed, constructed and maintained in accordance with R645-301-512.240, R645-301-514.300, R645-301-515.200, R645-301-533.100 through R645-301-533.600, R645-301-733.220 through R645-301-733.224, and R645-301-743.

The primary controls for limiting suspended solids and sediment to stream flow and runoff outside the permit area is sediment impoundments and diversions ditches. The proposed system described in section 742.110 is designed to control storm water/runoff discharges from the disturbed areas. Discharges from this system are expected to be minimal and infrequent. Discharges that may occur will comply with R645-301-751.

The impoundment and ditch system will be inspected regularly and discharges will be sampled for water quality purposes.

742.214

Water encountered underground will be stored and treated as needed in underground sumps. It is anticipated most or all of such water would be utilized in the underground mining operation. Excess water would only be discharged after meeting applicable UPDES standards.

742.220 Sedimentation Ponds.

742.221.1 The proposed sediment ponds are designed to be used individually

742.221.2 The locations for the sediment ponds were selected to be as near as possible to the disturbed areas and are not located in perennial streams

742.221.3 The ponds are designed and will be constructed and maintained to:

742.221.31 The ponds have been designed with excess capacity by at least 15% to allow for adequate sediment storage volume. The following table provides the design capacities in relation to a 24 hour duration, 100 year storm event:

| **Sedimentation Impoundment Capacities** | | | | |
|---|---|---|---|---|
| Structure | Storage Required (ac/ft) | Design Storage* (ac/ft) | Percent of requirement | Additional Storage (ac/ft) |
| 1 | 2.6 | 3.2 | 123 | 0.6 |
| 2 | 1.7 | 2.3 | 135 | 0.6 |
| 3 | 6.3 | 12.6 | 200 | 6.3 |
| 4 | 2.1 | 5.5 | 261 | 3.4 |
| 1B | 0.5 | 0.8 | 160 | 0.3 |

# APPENDIX 7-15

Coal Hollow Underground
Mining Probable Hyhrologic
Consequence

# Probable Hydrologic Consequences of Underground Coal Mining at the Alton Coal Development, LLC Coal Hollow Mine

25 November 2014
Modified 10 August 2015

Alton Coal Development, LLC
Cedar City, Utah

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

# Probable Hydrologic Consequences of Underground Coal Mining at the Alton Coal Development, LLC Coal Hollow Mine

25 November 2014
Modified 10 August 2015

Alton Coal Development, LLC
Cedar City, Utah

Prepared by:

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah P.G. No. 5373615-2250

PROFESSIONAL GEOLOGIST
PETERSEN
No. 5373615-2250
10 Aug 2015
STATE OF UTAH

PH
PETERSEN HYDROLOGIC, LLC
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## INTRODUCTION

The Alton Coal Development, LLC (ACD) Coal Hollow Mine is located approximately 3 miles south of the town of Alton, Utah (Figure 1). A permit to operate the Coal Hollow Mine was issued on 10 November 2010. The first coal was mined in early February 2011.

Alton Coal Development, LLC is currently applying for a permit from the Utah Division of Oil, Gas and Ming to conduct underground coal mining and reclamation activities within the existing Coal Hollow Mine permit area. The purpose of this document is to describe the Probable Hydrologic Consequences (PHC) of the proposed underground mining activities.

The reader is referred to the mining and reclamation plan for the Coal Hollow Mine (C0250005) for supporting information for this document. Detailed information regarding groundwater and surface-water systems in the Coal Hollow Mine permit and adjacent area is provided in Appendix 7-1 (Petersen Hydrologic, 2007) in the Coal Hollow Mine MRP.

Including this introduction, this report includes the following sections:

- Introduction
- Mining Overview
- Climate
- Geology
- Baseline Information
- Probable Hydrologic Consequences Determination
- Recommended Monitoring Plans for Surface Water and Groundwater
- References Cited

## MINING OVERVIEW

Prior to 2014, coal mining operations at the Coal Hollow Mine were performed using conventional surface mining (open pit) techniques. Beginning in 2014, ACD began using highwall mining techniques in selected portions of the mine permit area. Using highwall mining techniques, the coal resource can be extracted from an above-ground surface location without causing disturbance of the land surface overlying coal extraction areas. Because of the hydrogeologic characteristics of the bedrock unit present above the coal seam to be mined (the low-permeability Tropic Shale), highwall mining operations have been performed without any detectable disruption of overlying shallow alluvial groundwater systems or impacts to surface water resources (see monitoring information collected by ACD for the highwall mining activities). To date, while limited amounts of groundwater associated with the coal in Smirl Seam has been encountered during highwall mining operations, there has been no discharge of water to the surface from the highwall mining holes (Personal communication, Kirk Nicholes, 2014).

ACD is currently proposing to conduct coal mining operations in portions of the existing Coal Hollow Mine permit area using underground mining techniques. The areas proposed for underground mining operations are shown on Figure 2. The underground mine plan has been designed to incorporate full-support, first mining only. Accordingly, subsidence of the land surface overlying the underground mined areas is not anticipated. The use of underground mining techniques allows for the extraction of the coal resource in areas where the overburden thickness is greater than that in open pit mining areas. Additionally, because there is no associated surface disturbance overlying the mined areas, shallow groundwater systems and surface-water systems overlying mined areas are protected using underground mining techniques.

## CLIMATE

Climatological information, including temperature and precipitation data, have been routinely measured and recorded at the Alton, Utah weather station (420086) since 1928. The station is located in the town of Alton, approximately three miles north of the Coal Hollow Mine permit area. Climatological data collected at the Alton station for the 77-year period from 1928 to 2005 have been summarized by the Western Regional Climate Center (2013). The month with the minimum monthly average temperature at the Alton station is January (15.1 °F), while the month with the warmest average maximum temperature is July (82.6 °F). Total precipitation averages 16.40 inches. Precipitation in the Alton area occurs during two annual wet cycles. These include wintertime cyclonic storms which bring precipitation to the area (usually as snowfall), and summertime storms originating from convection in the Gulf of Mexico or the Pacific Ocean (Doelling, 1972). Average monthly precipitation at the Alton station ranges from a low of 0.57 inches in June to a maximum of 1.79 inches in January and February. The average monthly precipitation falling during the month of September is nearly as great, averaging 1.76 inches.

Wind data have been collected at the Coal Hollow Project weather station since December 2005. Wind data from the Coal Hollow Project weather station indicates that the predominant wind directions in the Coal Hollow Mine permit area are from the northeast, with secondary peaks from the north and south-southwest. Surface winds recorded at the Coal Hollow Project weather station averaged about 6.4 miles per hour. Wind data have also been collected historically at nearby locations by governmental and other entities. The regionally predominant direction of winds in the region is southwest through west. Secondary peaks are from southeast and northwest. Surface winds in the regional area average approximately 8 miles per hour. Higher wind speeds are associated with passage of weather fronts and storms and generally occur during the springtime.

## GEOLOGY

The geology of the Coal Hollow Mine permit and adjacent area is described in Chapter 6 of the Coal Hollow Mine MRP. Within the proposed underground mining area, Cretaceous Tropic Shale bedrock and Quaternary alluvium is exposed at the land surface. The Cretaceous Dakota Formation is present beneath the Tropic Shale in the proposed underground mining areas within the Coal Hollow Mine permit area. An east-west cross-section through the proposed underground mine workings is presented in Figure 3. These geologic units are described below.

### *Quaternary Deposits*

The Quaternary deposits in the proposed underground mining area consist predominantly of unconsolidated alluvial sediments (interbedded clays, silts, sands, and gravels). The alluvial sediments are derived from erosion of adjacent upland areas located further east. Drilling logs for selected holes drilled near the proposed underground mining areas are included in the Appendix. Within the proposed underground mining and surrounding areas, the alluvial deposits range from a thin veneer to more than 100 feet in thickness. A southeast-northwest hydrologic cross-section through the proposed underground mining area is provided in Drawing 6-12 in the Coal Hollow Mine MRP.

***Tropic Shale (Cretaceous)***

The Tropic Shale consists predominantly of gray and carbonaceous silty shale with a few marine sandstone beds. (Note that the sandstone beds are not present in the proposed underground mining area as the upper portion of the Tropic Shale in the proposed mining area has been removed by erosion). The Tropic Shale typically weathers at the surface to a clayey soil that typically forms gentle, vegetated slopes. The Tropic Shale is at or near the surface over much of the proposed underground mining area (See Drawings 6-1 and 6-9 in the Coal Hollow Mine MRP). In other areas, the Tropic Shale is covered by varying thicknesses of alluvium. The formation was deposited in an open-marine offshore environment during the maximum westward transgression of the Cretaceous Western Interior Seaway in the Late Cretaceous (Tilton, 2001). Near the top of the formation, more sandy horizons are interbedded with the mudstone units of the formation. These sandy units together with the sandstone at the base of the overlying Straight Cliffs Formation reflect the initial sand influx onto the marine environment of the Tropic Shale. The thickness of the Tropic Shale in the Alton Quadrangle is about 700 feet.

***Dakota Formation (Cretaceous)***

The Dakota Formation contains the economic coal seams in the Alton Coal Field. The formation consists of fine- to medium-grained sandstone (commonly lenticular) with interbedded gray shale, carbonaceous shale, and coal. In most locations, shaley strata dominate the formation, comprising about 60 to 75 percent of the formation (Doelling, 1972). Where exposed at the surface to the west of the proposed underground mining areas, the unit characteristically forms ledge and slope topography. In the Coal Hollow Project area the Dakota Formation directly overlies the Carmel Formation. The economic coal seams in the

Alton Coal Field are present near the base (Bald Knoll coal zone) and near the top of the formation (Smirl coal zone). Local thinner coal seams that are not of economic importance are present in the center of the formation. The thickness in the western portion of the Alton Coal Field is about 450 feet. In the eastern portion of the Alton Coal Field, the Dakota Formation is about 150 feet thick and rests on the Entrada Sandstone.

***Structure***

Rock strata in the region dip gently toward the north and east, generally from 1 to 5 degrees. The Alton Coal Field is bounded on the east by the Paunsaugunt Fault and on the west by the Sevier Fault. Regional displacements on these two faults are about 1,000 to 2,000 feet, and 100 to 800 feet, respectively. Additionally, several faults with lesser displacements have been mapped in the region, including the Sand Pass Fault zone (about 400 feet of offset), the Bald Knoll Fault (about 650 feet of offset), and the Sink Valley Fault. The Sink Valley Fault is mapped in the westernmost portions of the proposed underground mining area (Figure 2). The Sink Valley Fault has not been directly intercepted by surface-mining pits at the Coal Hollow Mine. The offset of the Sink Valley Fault in the proposed underground mining location has not been measured. However, drilling evidence suggests that the offset on the Sink Valley Fault in the vicinity is not large (perhaps on the order of 20 feet or less). A prominent geologic feature is the north-south trending ridge of Tropic Shale bedrock that is present in the western portion of the proposed underground mining area. The low-permeability bedrock ridge isolates alluvial groundwater systems east of the ridge with alluvial groundwater systems west of the ridge. Most local faults in the Alton Quadrangle trend in a northerly or north-westerly direction, are several miles long, and are near vertical. A prominent north- to northwest-trending vertical joint set is present in the Upper Cretaceous sandstone rocks in the region. Stratal dips vary appreciably near the fault zones.

## BASELINE HYDROLOGIC DATA

Large amounts of baseline hydrologic data have been collected from the Coal Hollow Mine permit and adjacent area. Utah International Inc. (1988) conducted baseline monitoring of springs, streams, and wells in and around the Coal Hollow Mine area as part of previous mine permitting activities. Hydrologic monitoring has also been performed in the Coal Hollow Mine and adjacent areas since 2005 as part of the permitting process for the existing Coal Hollow Mine. Over the more than nine years that Coal Hollow Mine's monitoring has occurred in and adjacent to the mine permit area, a large quantity of surface-water and groundwater quantity and quality data, including field and laboratory water quality data, spring and stream discharge rate data, and groundwater potentiometric data from wells has been collected. These data have been entered into the Utah Division of Oil, Gas and Mining's on-line coal water quality database and are freely accessible at http://linux1.ogm.utah.gov/cgi-bin/appx-ogm.cgi.

Drilling and well completion logs for wells Y-100 and Y-101, together with baseline hydrologic data for wells Y-100 and Y-101 are presented the Appendix.

## PROBABLE HYDROLOGIC CONSEQUENCES (PHC) DETERMINATION

This section describes the probable hydrologic consequences of coal mining and reclamation activities associated with the proposed underground mining activities in the existing Coal Hollow Mine permit area. The information presented herein is considered as a supplement to the existing Coal Hollow Mine PHC determination. This determination is based on data presented herein and on information provided elsewhere in the Coal Hollow Mine MRP. This section describes the specific hydrologic consequences associated with the proposed underground mining operations. The mining and reclamation plan has been designed to minimize potential adverse impacts to the hydrologic balance.

### Potential adverse impacts to the hydrologic balance

Appreciable adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur as a result of the proposed underground mining activities at the Coal Hollow Mine.

Using underground mining techniques, the coal reserves proposed for underground mining at the Coal Hollow Mine will be accessed from mine portals in surface-mining pit 10. Using the underground mining techniques, surface disturbance above proposed underground mining areas is not anticipated. The underground mining plan has been designed and engineered to prevent subsidence of the land surface overlying highwall mined areas. Consequently, impacts to overlying shallow alluvial groundwater systems are not anticipated.

Because of the necessity to maintain access to the underground mine portals in pit 10, pit 10 will remain open until the proposed underground mining is compete. This exceeds the typical 60 to 120 day period of time for which most mine pits remain open. Because pit 10 will remain open for an indefinite period of time, there is the potential for ongoing drainage of alluvial groundwater from the adjacent up-gradient alluvial groundwater system situated east of the mine pit. However, only a minimal amount of alluvial groundwater is currently seeping into pit 10 through the exposed alluvial sediments. ACD personnel estimate the total amount of alluvial groundwater currently seeping into pit 10 at about 2 gpm (Personal communication, Kirk Nicholes, 2014). This quantity of ongoing groundwater discharge from the pit 10 highwall is not believed to be of sufficient magnitude relative to the total volume of groundwater in storage in the alluvial groundwater system to cause appreciable impacts to the shallow alluvial groundwater system east of pit 10. As a first order approximation for comparison, alluvial sediments occupying a hypothetical area of that is 0.25 miles long by 0.25 miles wide (1/16 square mile) that is 30 feet thick with an effective porosity of 0.25 could hold about 13.1 million cubic feet (about 98 million gallons) of groundwater in storage. A constant discharge of 2 gpm equates with a discharge of about 1.1 million gallons of water per year. Thus, the 2 gpm discharge of alluvial groundwater into pit 10 represents roughly 1.1 percent of the total volume of water in the hypothetical alluvial groundwater system per year. This volume of groundwater is small relative to the volume in storage and to the volume of annual recharge that likely occurs in the shallow alluvial groundwater system.

The proposed underground mine openings will exist entirely within the Smirl coal seam. Appreciable excavation of the Dakota Formation underlying the Smirl coal seam is not anticipated (and would be undesirable from a mining standpoint). Likewise, the proposed underground mining plan calls for a portion of the Smirl coal seam to be left unmined in the mine roof, and thus disturbance of the overlying Tropic Shale formation should not occur.

If the proposed underground mine workings were to come into hydraulic communication with permeable units of the overlying alluvial groundwater systems, alluvial groundwater could potentially drain into the underground mine openings, depleting the quantity of water present in the overlying alluvial groundwater system. However, where there is the presence of considerable thicknesses of low-permeability Tropic Shale bedrock in the zone extending from the top of the Smirl coal seam to the base of the overlying alluvial groundwater systems, it is considered unlikely that this would occur. The thicknesses of Tropic Shale bedrock that exist in the interburden between the top of the coal seam and the base of the alluvial groundwater system in the vicinity of the proposed underground mining locations at monitoring well Y-101 is more than 170 feet (based on well information for Y-101 and a projected top-of-Smirl-coal-seam elevation at the Y-101 location of about 6752 feet (ACD, 2014)). The potential for any appreciable quantity of alluvial groundwater to migrate through such a zone of Tropic Shale is considered minimal.

It has previously been suggested that groundwater in the Smirl coal seam near wells Y-36 and Y-48 may be in hydraulic communication with the overlying alluvial groundwater system in the vicinity of these wells (UII, 1987; see Figure 4 of Petersen Hydrologic, 2013 for well locations). Although there are uncertainties as to this conclusion, in the event that there is communication between the alluvial groundwater system and the Smirl coal seam, then there would be a potential for alluvial groundwater to enter into underground mine openings in such areas. If there were to be hydraulic communication with the overlying alluvial groundwater system, the volume of water that would be intercepted would likely be proportional to the hydraulic conductivity of the Smirl coal seam. Aquifer testing at Y-36 did not indicate high values of hydraulic conductivity for the interval screened in that well ($1 \times 10^{-5}$ cm/s; UII, 1987).

If any Utah State appropriated water rights are impacted by the proposed underground mining and reclamation operations at the Coal Hollow Mine, these will be replaced according to all applicable Utah State laws and regulations using the designated water replacement source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

*Monitoring wells and geologic borings*

No previous coal mining is known to have occurred within the proposed underground mining areas at the Coal Hollow Mine permit area. However, during several decades prior to the commencement of coal mine permitting activities by Alton Coal Development, LLC in 2005, it is known that several operators performed various permitting activities, conducted coal exploration drilling programs, and performed miscellaneous environmental studies in conjunction with the these permitting activities. In conjunction with these activities, it is known that numerous monitoring wells were drilled and completed, geologic borings were made, and miscellaneous other drilling activities occurred within the Coal Hollow Mine and adjacent areas. If the proposed underground mine workings were to intersect an open borehole or improperly abandoned well, there would be the potential for groundwaters from overlying areas (if saturated permeable zones are present at that location) to flow through the open boreholes into the underground mine workings at appreciable rates. To minimize the potential for this occurrence, where possible identified historic monitoring well and geologic boring locations that penetrated to the Smirl coal seam will be avoided in the proposed underground mining operations.

**Presence of acid-forming or toxic-forming materials**

Chemical information on the acid- and toxic-forming potential of earth materials naturally present in the existing mine permit area are presented in the Coal Hollow Mine MRP (Appendix 6-2). Chemical information on the low-sulfur Smirl coal seam proposed for mining is presented in the Coal Hollow Mine MRP (Appendix 6-1; confidential binder).

Based on laboratory analytical data, it is apparent that acid-forming and toxic-forming materials that could result in the contamination of surface-water or groundwater supplies in the proposed Coal Hollow Mine permit and adjacent area are generally not present.

Selenium was not detected in any of the samples from the Coal Hollow Mine permit area. Likewise, concentrations of water-extractable boron were also low, being less than 3 mg/kg in all samples analyzed. The pH of groundwaters in and around the Coal Hollow Mine permit area is moderately alkaline (UDOGM, 2013). Data in the Coal Hollow Mine MRP (Appendix 6-2) likewise indicate moderately alkaline conditions in sediments in the existing mine permit area. The solubility of many dissolved trace metals is usually limited in waters with alkaline pH conditions. Consequently, high concentrations of these metal constituents in groundwaters and surface waters with elevated pH levels are not anticipated.

At the conclusion of the underground mining activities at the Coal Hollow Mine, the portals area in Pit 10 will be backfilled and reclaimed. Most of the materials that are handled as part of mining and reclamation activities in the Coal Hollow Mine area are of low hydraulic conductivity (i.e. clays, silts, shales, siltstones, claystones, etc.). Consequently, it has been the experience at the Coal Hollow Mine that groundwater seepage volumes through low-permeability backfill and reclaimed land surfaces in reclaimed mine pit areas and excess spoils storage areas have not been large. Such conditions are anticipated during future operations at the Coal Hollow Mine. Additionally, reclaimed areas will be regraded, sloped, and otherwise managed to minimize the potential for land erosion, to restore approximate surface-water drainage patterns, and also to minimize the potential for ponding of surface waters on reclaimed areas (other than "roughening" or "gouging" of some areas to enhance reclamation). Thus, the potential for interactions between large amounts of disturbed earth materials and groundwaters and surface waters, which could result in leaching of chemical constituents into groundwater and surface-water resources, will be minimized.

Additionally, the mining plan calls for the emplacement of 40 inches of suitable cover material over backfilled areas made up of material types which could appreciably impact vegetation (materials with elevated SAR ratios or other physical or chemical characteristics that could adversely impact vegetation).

The neutralization potential greatly exceeded the acid potential in all samples analyzed, with the neutralization potential commonly exceeding the acid potential by many times, suggesting that acid-mine-drainage will not be (and has not been) a concern at the Coal Hollow Mine. Acid-forming materials in western coal mine environments often consist of sulfide minerals, commonly including pyrite and marcasite, which, when exposed to air and water, are oxidized causing the liberation of $H^+$ ions (acid) into the water. Oxidation of sulfide minerals may occur in limited amounts in the mine pits where oxygenated water encounters sulfide minerals. However, the acid produced by pyrite oxidation is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (see Coal Hollow Mine MRP; Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well-aerated waters, and consequently excess iron is not anticipated (nor is it usually present) in mine discharge water.

Other acid-forming materials or toxic-forming materials have not been identified in significant concentrations nor are such suspected to exist in materials to be disturbed by mining.

**Sediment yield from the disturbed area**

Potential increases in sediment yield associated with the proposed underground mining activities at the Coal Hollow Mine will be limited to disturbed areas associated with the Pit 10 disturbance (portals location). Because no land subsidence or other surface disturbances are anticipated in areas overlying underground mining areas, increased sediment yield from these areas should not occur. Within the pit 10 portals area as well as along the coal haul roads, erosion from disturbed areas will be minimized through the use of silt fences and other sediment control devices. Surface runoff occurring on disturbed areas will be collected and treated as necessary to remove suspended matter.

Cut ditches will be established on the shoulders of all primary roads to control drainage and erosion. Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. In locations where there are culvert crossings, the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles. The location and details for roads can be viewed in Chapter 5 of the Coal Hollow Mine MRP (Drawings 5-3 and 5-22 through 5-24).

Through the implementation of these sediment control measures, it is anticipated that sediment yield from disturbed areas in the Coal Hollow Mine permit area will continue to be minimized.

**Impacts to important water quality parameters**

As discussed above, appreciable quantities of intercepted groundwater are not anticipated in connection with the proposed underground mining operations at the Coal Hollow Mine due primarily to the lack of appreciable groundwater systems in the overlying low-permeability Tropic Shale. Similarly, appreciable quantities of groundwater are not expected to upwell from the Dakota Formation into the proposed underground mine openings. This conclusion is based on the fact that 1) vertical and horizontal groundwater flow in the Dakota Formation is impeded by the presence of low-permeability shales that encase the interbedded lenticular sandstone strata in the formation (i.e., the formation is not a good aquifer), and 2) appreciable natural discharge from the Dakota Formation in the surrounding area to springs or streams is not observed. Similarly, no appreciable inflows of groundwater from the Dakota Formation into the previously mined pits at the Coal Hollow Mine have been observed. Rather, as anticipated, the only appreciable source of groundwater inflow to the mine pit areas has been from saturated near-surface alluvial deposits. These observations support the conclusion that the natural flux of groundwater through the Dakota Formation is meager. The results of aquifer testing performed on wells screened in the Smirl coal seam indicate relatively low values of hydraulic conductivity for the coal seam (see Table 7 of Appendix 7-1 of the Coal Hollow Mine MRP), suggesting that it is unlikely that large inflows of water from the Smirl coal seam into the proposed underground mining areas would occur. Accordingly, because it is considered unlikely that large quantities of groundwater will be intercepted during the proposed underground mining operations (from either the Tropic Shale or the Dakota Formation), it is likely that discharge of large quantities of intercepted groundwater from the mine to receiving waters (such that impacts to important water quality parameters in the receiving waters could occur) will not occur. For these reasons, it is considered unlikely that impacts to important water quality parameters in groundwater and/or surface water resources in the mine area will occur as a result of the proposed underground mining operations at the Coal Hollow Mine.

The water quality of groundwaters in the alluvial groundwater system up-gradient of the proposed underground mining operations will likely not be impacted by mining and reclamation activities in the proposed underground mining areas at the Coal Hollow Mine. In the unlikely event that alluvial groundwaters were to be intercepted by the proposed underground coal mine workings, there would be the potential for increased TDS concentrations if the groundwater were allowed to interact with the marine Tropic Shale.

As groundwater naturally migrates through the shallow, fine-grained alluvial sediments in the Coal Hollow Mine permit and adjacent area (most evident in Sink Valley), the quality of the water is naturally degraded. In the distal portions of Sink Valley, most notably concentrations of magnesium, sulfate, and bicarbonate are elevated in the alluvial groundwater.

The potential for TDS increases associated with interaction of waters with the Tropic Shale can be minimized by avoiding contact where practical between water sources and earth materials containing soluble minerals.

As discussed above, acid mine drainage is not anticipated (nor has it been encountered) at the Coal Hollow Mine permit area. This is due primarily to the relatively low sulfur content of the coal and rock strata in the permit and adjacent area, and to the pervasiveness of carbonate minerals in the soil and rock strata which neutralize the acidity of the water if it occurs. If sulfide mineral oxidation and subsequent acid neutralization via carbonate dissolution were to occur, increases in TDS, calcium, magnesium, sulfate, and bicarbonate concentrations (and possibly also sodium concentrations via ion-exchange with calcium or magnesium on exchangeable clays) would be anticipated.

At any mining operation there is the potential for contamination of soils, surface-water and groundwater resources resulting from the spillage of hydrocarbons. Diesel fuels, oils, greases, and other hydrocarbons products will be stored and used at the mine site for a variety of purposes. A spill Prevention Control and Countermeasure Plan has been implemented at the Coal Hollow Mine that helps to minimize any potential detrimental impacts to the environment.

Spill control kits are provided on all mining equipment and personnel will be trained to properly control spills and dispose of any contaminated soils in an appropriate manner.

While some groundwater will likely be encountered in the proposed Coal Hollow Mine underground workings, appreciable, persistent groundwater inflows are not anticipated. The Tropic Shale formation which directly overlies the Smirl coal seam consists predominantly of soft, silty claystone/shale. The hydraulic conductivity of the Tropic Shale is low. To verify this conclusion, an unweathered sample of the shale obtained from core drilling activities was sent to an analytical laboratory for measurement of hydraulic conductivity. The core sample was remolded and compacted at the laboratory prior to analysis. The measured laboratory hydraulic conductivity was $8.24 \times 10^{-8}$ cm per second, which indicates a very low potential for the migration of groundwater through the material. The presence of the Tropic Shale in the mine overburden minimizes the potential for vertical recharge of groundwater from overlying potential recharge sources to the coal seam or to underlying geologic formations. Because of the soft, plastic character of the Tropic Shale and the presence of bentonite clay layers throughout the formation, the potential for migration of groundwater through any mining-induced fractures that could potentially form in the overburden is low. The low permeability of the Tropic Shale bedrock also minimizes the potential for groundwater flow through the formation to potential discharge locations (i.e. springs or seeps). This conclusion is supported by the lack of springs or seeps in the Tropic Shale bedrock in the area.

As discussed in Chapters 6 and 7 of the Coal Hollow Mine MRP, the Dakota Formation in the vicinity of the Coal Hollow Mine consists predominantly of shaley strata interbedded with lenticular fine- to medium-grained sandstone and coal. Because of the pervasiveness of interbedded low-permeability horizons in the formation and the vertical and lateral discontinuity of sandstone horizons, the potential for vertical and horizontal movement of groundwater is limited. Although aquifer-quality sandstone strata may exist within the formation, appreciable groundwater migration through the formation over large distances likely does not occur due to the lenticular, discontinuous nature of these permeable sandstones. For this reason, although some modest groundwater inflows into the underground mine workings could potentially occur if saturated sandstone members are encountered in the immediate mine floor, because of the discontinuous nature of these sandstone members, large, sustained inflows of groundwater into the proposed underground mine workings through the Dakota Formation in the mine floor are not anticipated. This conclusion is supported by the fact that little or no groundwater has upwelled from the Dakota Formation into mine pit areas where its upper contact has been exposed by mining at the Coal Hollow Mine.

Similarly, while some minor amounts of groundwater have occasionally been encountered within the Smirl coal seam at the Coal Hollow Mine, large or sustained groundwater inflows through the coal seam have not been encountered. This is likely due because 1) the hydraulic conductivity and porosity of the Smirl coal seam is low, and 2) there is little potential for recharge of the coal seam through the overlying low-permeability Tropic Shale bedrock.

For these reasons, the overall potential for the interception of large amounts of groundwater in the proposed Coal Hollow Mine underground workings is considered low. However, in the event that appreciable water is encountered in the underground workings, Alton Coal Development, LLC will handle and monitor groundwater intercepted in appreciable, sustained quantities in the underground mine workings.

Because the Smirl coal seam dips generally to the east or northeast in the area, the developed mine workings will generally dip in the same direction. As a result, intercepted groundwaters in the underground mine openings will tend to gravity flow away from the mine portals towards deeper, down-dip portions of the mine. Consequently, for these reasons, and because only small amounts of groundwater are expected to be encountered, gravity discharge of groundwaters from the mine portals is not anticipated.

Where possible, groundwater intercepted in the underground mine workings will be managed underground by allowing any groundwater that is encountered to accumulate in underground sumps and/or by utilizing the mine water for in-mine process water.

In the unanticipated event that large, sustained groundwater inflows are encountered within the Coal Hollow Mine underground mine workings (a groundwater inflow greater than 250 gpm that is sustained for at least one month) Alton Coal Development, LLC will commission an investigation of the likely source and water quality characteristics of the groundwater inflow to be performed by a qualified Hydrogeologist. The results of the investigation will be provided to the Division of Oil, Gas and Mining. ACD will also monitor the groundwater inflow rates from such an inflow monthly and report the results of these measurements to the Utah Division of Oil, Gas and Mining on a quarterly basis.

**Flooding or streamflow alteration**

Appreciable groundwater inflows to the proposed underground mine workings at the Coal Hollow Mine are not anticipated and, accordingly, no substantial discharges of mine water from the proposed workings are anticipated. This conclusion is based on the hydrogeologic characteristics of the Tropic Shale, Dakota Formation, and the Smirl coal seam and previous operational experience at the Coal Hollow Mine. During previous mining operations at the Coal Hollow Mine, appreciable groundwater inflows to the mine pits or highwall mining holes were not encountered from the Tropic Shale, Smirl coal seam, or Dakota Formation. Appreciable groundwater inflows from fault zones were likewise not encountered. Faults with significant displacements have not been identified in the proposed underground mining area (the local offset on the Sink Valley Fault is not known, but is thought to be less than 20 feet). The only appreciable groundwater inflows that have been encountered during mining operations at the Coal Hollow Mine have been from saturated shallow alluvial sediments overlying the Tropic Shale. The historical rate of alluvial groundwater interception at the Coal Hollow Mine has been modest, usually on the order of a few tens of gallons per minute or less over the entire extent of the open pit and highwall mining areas. The proposed underground mine workings have been designed to avoid the overlying shallow alluvial groundwater systems. The alluvial groundwaters will be isolated from the underground mine environment by low-permeability Tropic Shale bedrock, which contains interbedded layers of bentonite clay. For all these reasons, the potential for interception of large amounts of groundwater in the proposed underground mine workings is considered low.

Discharge of groundwater to the surface will be necessary only if the quantity of water intercepted exceeds that which can be managed within the underground mine workings or within the sediment ponds. Because of the general easterly (or northeasterly) dip of the Smirl coal seam, the underground mine workings will dip away from the mine portal area. Thus, intercepted groundwaters that may be encountered will tend to flow down dip (generally to the east) away from the mine portal area toward the deepest portions of the mine.

Because appreciable discharge of mine water from the underground mine workings is not anticipated, there is correspondingly no significant potential that such discharge would cause flooding or streamflow alteration in the receiving water (Lower Robinson Creek). In the unanticipated event that it becomes necessary to discharge modest quantities of water from the underground mines workings, the potential for such discharge to cause flooding or streamflow alteration would likely be low. The surface-water drainages adjacent to the Coal Hollow Mine permit area have large discharge capacities (lower Sink Valley Wash, Lower Robinson Creek, and Kanab Creek). These drainages periodically convey very large amounts (many thousands of gallons per minute) of precipitation water from intense runoff associated with torrential precipitation events. The anticipated maximum discharge rates from the proposed underground mine workings based on any reasonably foreseeable scenario is much less than that periodically occurring during major torrential precipitation events. While the addition of modest amounts of sediment-free water into the Lower Robinson Creek stream channel has the potential to cause some increases in channel erosion, the magnitude of this potential impact would likely be inconsequential relative to that occurring during torrential precipitation events.

It should be emphasized that the stream channels in the Coal Hollow Mine area (including Lower Robinson Creek) are in many locations not stable in their current configurations. Kanab Creek, Lower Robinson Creek, and Sink Valley Wash are all currently experiencing downcutting during large precipitation events that can create near-vertical streambanks that are unstable and result in mass wasting into the channels (BLM, 2015). The movement of large quantities of sediment during the springtime snowmelt and large precipitation events modifies these stream channels on a regular basis (BLM, 2015). Consequently, it is considered highly likely that there will be substantial changes to some reaches of the Lower Robinson Creek stream channel in the future – even in the absence of any discharge of water to the creek from the proposed underground mine workings. Such changes could occur as a result of erosional processes and/or sediment deposition processes. As described above, given that there will likely be little or no discharge from the underground mine workings to Lower Robinson Creek, the magnitude of any potential changes to the stream channel resulting from mine-water discharge would likely be overwhelmed by changes resulting from pre-existing natural processes in the drainage.

The mining plan for the proposed underground mining operations has been designed to prevent material damage to the hydrologic balance outside the permit area. The mining plan includes commitments to discharge water from the Underground Mine in compliance with all the stipulations of the UPDES permit as administered by the Utah Division of Water Quality. The plan also includes commitments to use sediment ponds, silt fences, and other sediment control devices to remove sediment from waters prior to discharge to receiving waters. As described above, the underground mining plan has been designed to minimize the potential for mine water discharge – which minimizes the potential for flooding or streamflow alteration in stream drainages outside the permit area. The plan also includes a commitment that in the event that any State appropriated waters were to be contaminated, diminished, or interrupted due to mining and reclamation activities in the Coal Hollow Mine permit area, the water will be replaced according to all applicable State laws and regulations using the replacement water source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

The potential for flooding or streamflow alteration resulting from the proposed underground mine operations at the Coal Hollow Mine permit is considered minimal.

**Groundwater and surface water availability**

Groundwater use in the Coal Hollow Mine permit and adjacent area is generally limited to stock watering and domestic use in Sink Valley. Some limited use of spring discharge water for irrigation has occurred in Sink Valley, although such irrigation is not occurring presently nor has it occurred in at least the past 10 years.

As discussed previously, there is only a limited potential for the interception of appreciable quantities of groundwater during the proposed underground mining operations at the Coal Hollow Mine. Consequently, the potential for impacts to groundwater and surface-water availability as a result of the proposed underground mining operations is considered low.

**Whether mining and reclamation activity will result in contamination, diminution or interruption of State-appropriated waters**

As discussed previously, it is considered unlikely that impacts to groundwater or surface-water resources will occur as a result of the proposed underground mining operations at the Coal Hollow Mine. Consequently, the potential for the proposed underground mining activities to result in the contamination, diminution, or interruption of State-appropriated waters is considered low. In the event that any State appropriated waters were to be contaminated, diminished, or interrupted due to mining and reclamation activities in the Coal Hollow Mine permit area, the water will be replaced according to all applicable State laws and regulations using the replacement water source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

## RECOMMENDED MONITORING PLANS FOR SURFACE WATER AND GROUNDWATER

In order to monitor for potential impacts to surface-water and groundwater resources resulting from the proposed underground mining and reclamation activities at the Coal Hollow Mine, we recommend the continued monitoring of the existing groundwater and surface-water monitoring sites in the vicinity of the proposed underground mining at the sites listed below. The locations of these recommended monitoring sites are shown on Figure 2 and Drawing 7-10 of the Coal Hollow Mine MRP. We also recommend monitoring of two additional alluvial groundwater monitoring wells. These include wells Y-101 and Y-100, which are located adjacent to and up-gradient of the proposed underground mining areas (Figure 2). It is noted that most of these locations are currently included on the Coal Hollow Mine groundwater and surface-water monitoring plan for other reasons. We recommend that the monitoring frequency and monitoring protocols that are listed in Table 7-4 be used for the monitoring associated with proposed underground mining at the Coal Hollow Mine.

***GROUNDWATER***

***Springs***

SP-8 (alluvial spring adjacent to underground mining area)

SP-14 (alluvial spring in underground mining area)

SP-16 (alluvial spring adjacent to underground mining area)

SP-20 (alluvial spring adjacent to underground mining area)

***Wells***

C1-24 (alluvial monitoring well adjacent to underground mining area)

UR-70 (alluvial monitoring well adjacent to underground mining area)

Y-102 (alluvial monitoring well adjacent to underground mining area)

C2-15 (alluvial monitoring well adjacent to underground mining area)

C2-28 (alluvial monitoring well adjacent to underground mining area)

C2-40 (alluvial monitoring well adjacent to underground mining area)

Y-61 (alluvial monitoring well adjacent to underground mining area)

Y-36 (Smirl coal seam monitoring well adjacent to underground mining area)

Y-100 (alluvial monitoring well up-gradient from underground mining area)

Y-101 (alluvial monitoring well within underground mining area)

***SURFACE WATER***

SW-101 (Lower Robinson Creek below underground mining area)

SW-6 (Sink Valley Wash below underground mining area)

The recommended monitoring plan for groundwater and surface-water monitoring for the proposed underground mining at the Coal Hollow Mine is intended to provide verification that mining-related impacts to groundwater and surface-water systems do not occur, and to determine the magnitude and character of potential impacts if they do occur. Comparisons between monitoring data (for the parameter of interest or concern) collected during baseline pre-mining conditions should be made with monitoring data (for the same parameter or interest of concern) collected during the operational and/or reclamation phase of mining to determine impacts. When changes to monitored parameters subsequent to mining in an area are observed in the monitoring data, an analysis of all data should be performed to determine the cause(s) of the change in the hydrologic condition. In utilizing the monitoring data to detect or quantify potential mining-related impacts, it is necessary to evaluate all factors relevant to the prevailing hydrologic conditions together with the monitoring data. This is because other factors, which are not related to the mining activity, may cause changes in the prevailing hydrologic conditions. In particular, climatic variability (which may result in increased or decreased groundwater and surface-water flow rates, changes in water levels in wells, and changes in water quality) should be carefully evaluated together with the monitoring data. Other factors that may influence coal mine hydrology include grazing practices, land use, and range condition. A convenient and useful means of evaluating regional climatic data is through the use of the Palmer Hydrologic Drought Index, which is a monthly value that indicates the severity of wet and dry spells that is generated by the National Climatic Data Center and available on-line at http://www1.ncdc.noaa.gov/pub/data/cirs/drd964x.phdi.txt.

The use of Stiff (1951) diagrams is a useful technique that is frequently used to analyze and compare groundwater and surface-water quality characteristics from various sources. Information required to create Stiff diagrams is available from the Division of Oil, Gas and Mining Coal Water Quality Database, which is freely accessible at: http://ogm.utah.gov/coal/edi/wqdb.htm. Additional information on coal mining hydrology and potential mining-related impacts, which can be used to assist in the evaluation of monitoring data and potential mining-related impacts is provided on the Utah Division of Oil, Gas and Mining web page at http://ogm.utah.gov/coal/water/default.htm.

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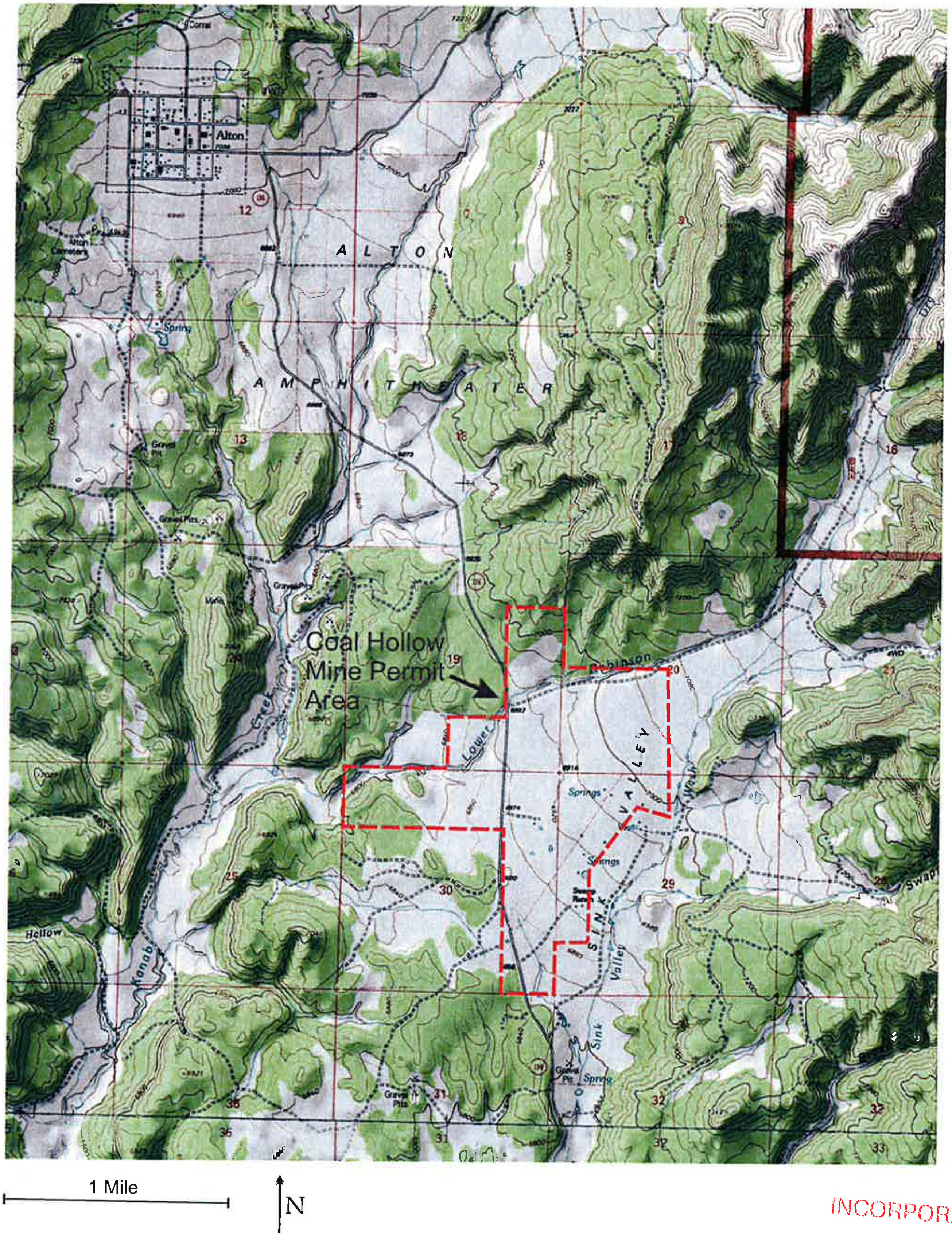



Figure 1 Location of the Coal Hollow Mine permit area.

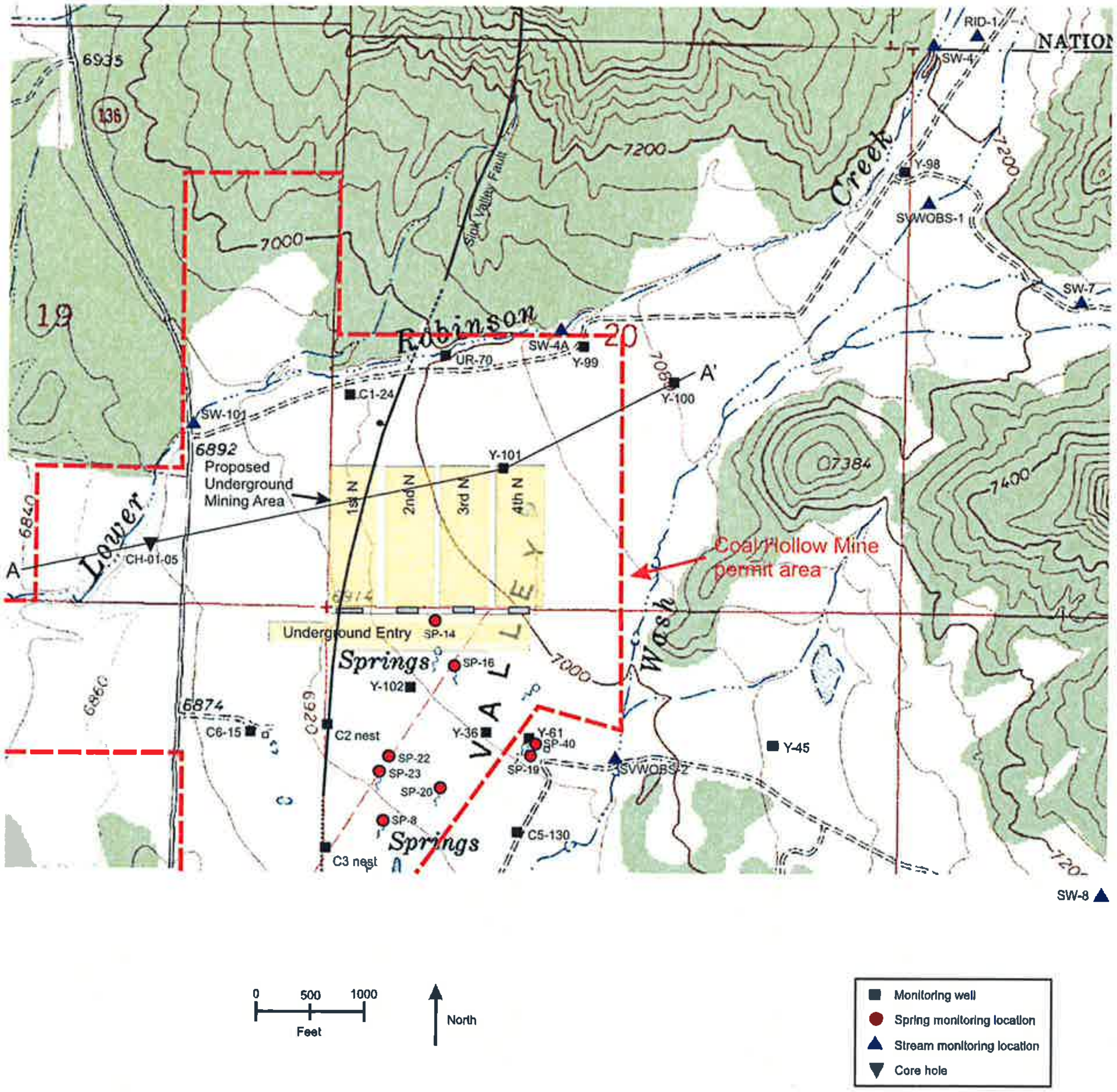
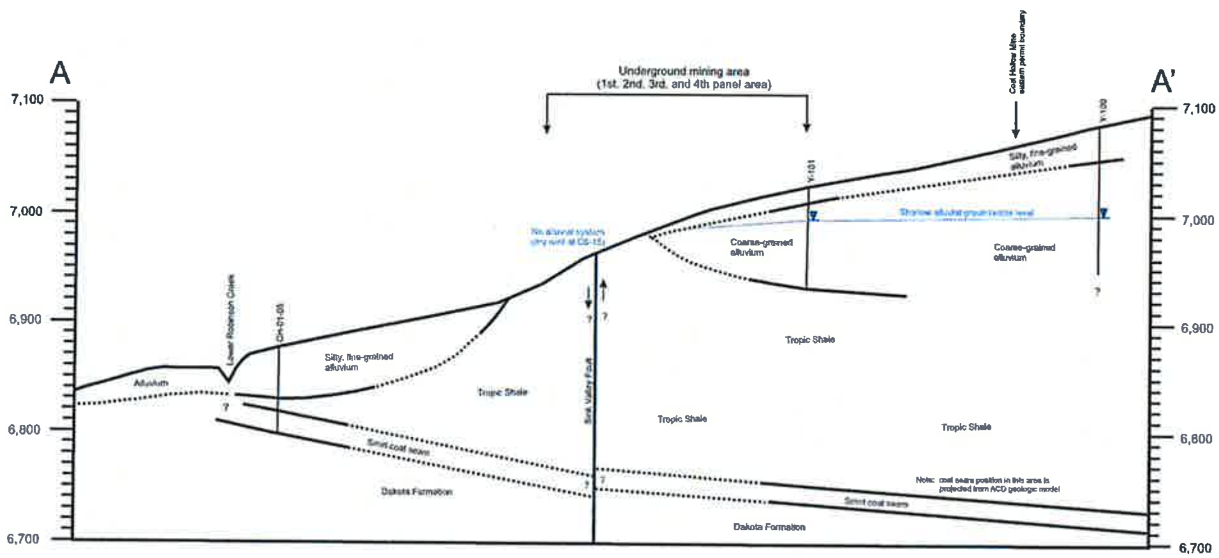



Figure 2 Map showing proposed underground mining areas and selected hydrologic monitoring points. The location for the cross-section A-A' in Figure 3 is also shown.




Note: The pre-mining geology is shown

Note: The location for this cross-section is shown on Figure 2.

1,000 feet

6.7 times vertical exaggeration

ERIK CARL PETERSEN

Figure 3 Generalized east-west cross-section through the proposed underground mining area at the Coal Hollow Mine.

**Appendix A**

Drilling and completion logs and baseline hydrologic data for selected wells near the proposed underground mining areas at the Coal Hollow Mine

Water level and water quality data for selected wells near the proposed underground mining area at the Coal Hollow Mine.

| Site | Date | W.L. (feet below toc) | | T | pH | Cond | TDS |
|---|---|---|---|---|---|---|---|
| Y-98 (A1) | 2-Jul-87 | --- | 7094.10 | 9.5 | 7.35 | 1055 | --- |
| Y-98 (A1) | 4-Aug-87 | --- | 7094.10 | 7.35 | 975 | 10 | --- |
| Y-98 (A1) | 16-Sep-87 | --- | 7091.75 | 11.2 | 7.3 | 635 | 346 |
| Y-98 (A1) | 27-Oct-87 | --- | 7091.10 | 11.9 | 7.2 | 795 | --- |
| Y-98 (A1) | 15-Nov-87 | --- | 7091.00 | 6.1 | 7.1 | 920 | --- |
| Y-98 (A1) | 9-Dec-87 | --- | 7091.33 | 8.9 | 7.3 | 955 | 548 |
| Y-98 (A1) | 5-Jan-88 | --- | 7090.90 | 7.7 | 7.5 | 675 | --- |
| Y-98 (A1) | 20-Feb-88 | --- | 7090.00 | 8.1 | 7.4 | 610 | --- |
| Y-98 (A1) | 18-Mar-88 | --- | 7092.30 | 8.9 | 7.0 | 1000 | 600 |
| Y-98 (A1) | 5/27/2005 | 81.00 | 7054.50 | --- | --- | --- | --- |
| Y-98 (A1) | 9/25/2005 | 71.46 | 7064.04 | --- | --- | --- | --- |
| Y-98 (A1) | 11/4/2005 | 78.89 | 7056.61 | --- | --- | --- | --- |
| Y-98 (A1) | 1/25/2006 | 82.69 | 7052.81 | --- | --- | --- | --- |
| Y-98 (A1) | 5/29/2006 | 81.48 | 7054.02 | --- | --- | --- | --- |
| Y-98 (A1) | 9/8/2006 | 84.67 | 7050.83 | --- | --- | --- | --- |
| Y-98 (A1) | 12/21/2006 | 85.24 | 7050.26 | --- | --- | --- | --- |
| Y-98 (A1) | 3/28/2007 | 84.84 | 7050.66 | --- | --- | --- | --- |
| Y-98 (A1) | 6/21/2007 | 84.79 | 7050.71 | --- | --- | --- | --- |
| Y-98 (A1) | 9/29/2007 | 85.02 | 7050.48 | --- | --- | --- | --- |
| Y-98 (A1) | 11/29/2007 | 85.13 | 7050.37 | --- | --- | --- | --- |
| Y-98 (A1) | 6/18/2008 | 84.71 | 7050.79 | --- | --- | --- | --- |
| Y-98 (A1) | 8/20/2008 | 84.88 | 7050.62 | --- | --- | --- | --- |
| Y-98 (A1) | 3/19/2009 | 85.45 | 7050.05 | --- | --- | --- | --- |
| Y-98 (A1) | 5/25/2009 | 85.08 | 7050.42 | --- | --- | --- | --- |
| Y-98 (A1) | 9/29/2009 | 85.59 | 7049.91 | --- | --- | --- | --- |
| Y-98 (A1) | 11/17/2009 | 85.59 | 7049.91 | --- | --- | --- | --- |
| Y-98 (A1) | 4/22/2010 | 85.70 | 7049.80 | --- | --- | --- | --- |
| Y-98 (A1) | 5/13/2010 | 85.28 | 7050.22 | --- | --- | --- | --- |
| Y-98 (A1) | 9/27/2010 | 84.67 | 7050.83 | --- | --- | --- | --- |
| Y-98 (A1) | 12/8/2010 | 84.69 | 7050.81 | --- | --- | --- | --- |
| Y-98 (A1) | 3/27/2011 | 84.69 | 7050.81 | --- | --- | --- | --- |
| Y-98 (A1) | 6/2/2011 | 79.24 | 7056.26 | --- | --- | --- | --- |

| Site | Date | W.L. (feet below toc) | | T | pH | Cond | TDS |
|---|---|---|---|---|---|---|---|
| Y-98 (A1) | 9/8/2011 | 74.98 | 7060.52 | --- | --- | --- | --- |
| Y-98 (A1) | 12/23/2011 | 84.60 | 7050.90 | --- | --- | --- | --- |
| Y-98 (A1) | 3/30/2012 | 84.21 | 7051.29 | --- | --- | --- | --- |
| Y-98 (A1) | 6/22/2012 | 84.64 | 7050.86 | --- | --- | --- | --- |
| Y-98 (A1) | 9/29/2012 | 85.03 | 7050.47 | --- | --- | --- | --- |
| Y-98 (A1) | 12/13/2012 | 85.32 | 7050.18 | --- | --- | --- | --- |
| Y-98 (A1) | 3/14/2013 | 85.18 | 7050.32 | --- | --- | --- | --- |
| Y-98 (A1) | 6/2/2013 | 85.37 | 7050.13 | --- | --- | --- | --- |
| Y-98 (A1) | 9/29/2013 | 85.84 | 7049.66 | --- | --- | --- | --- |
| Y-98 (A1) | 12/19/2013 | 85.90 | 7049.60 | --- | --- | --- | --- |
| Y-98 (A1) | 3/30/2014 | 85.74 | 7049.76 | --- | --- | --- | --- |
| Y-98 (A1) | 6/16/2014 | 85.64 | 7049.86 | --- | --- | --- | --- |
| | | | | | | | |
| Y-99 (A2) | 7/2/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 8/4/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 9/16/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 10/27/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 11/15/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 12/4/1987 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 1/5/1988 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 2/20/1988 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 3/18/1988 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 5/25/2005 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 5/27/2005 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 11/4/2005 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 5/29/2006 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 9/8/2006 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 12/21/2006 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 3/28/2007 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 6/21/2007 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 9/29/2007 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 11/29/2007 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 3/22/2008 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 3/30/2008 | Dry | <7040.5 | --- | --- | --- | --- |

| Site | Date | W.L. (feet below toc) | | T | pH | Cond | TDS |
|---|---|---|---|---|---|---|---|
| Y-99 (A2) | 6/18/2008 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 8/20/2008 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 12/30/2008 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 3/19/2009 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 5/25/2009 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 9/29/2009 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 11/17/2009 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 4/22/2010 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 5/13/2010 | Dry | <7040.5 | --- | --- | --- | --- |
| Y-99 (A2) | 9/27/2010 | Dry | <7040.5 | --- | --- | --- | --- |
| | | | | | | | |
| Y-100 (A3) | 7/2/1987 | --- | 7007.70 | 10.4 | 7.15 | 740 | --- |
| Y-100 (A3) | 8/4/1987 | --- | 7007.60 | 9.5 | 7.35 | 825 | --- |
| Y-100 (A3) | 9/16/1987 | --- | 7007.26 | 9.9 | 7.00 | 755 | 446 |
| Y-100 (A3) | 10/27/1987 | --- | 7006.80 | 9.9 | 6.9 | 930 | --- |
| Y-100 (A3) | 11/15/1987 | --- | 7006.50 | 7.8 | 7.3 | 765 | --- |
| Y-100 (A3) | 12/9/1987 | --- | 7006.37 | 8.2 | 7.10 | 760 | 440 |
| Y-100 (A3) | 1/5/1988 | --- | 7005.90 | 8.2 | 7.2 | 740 | --- |
| Y-100 (A3) | 2/20/1988 | --- | 7005.50 | 8.5 | 7.5 | 750 | --- |
| Y-100 (A3) | 3/18/1988 | --- | 7005.46 | 8.4 | 7.00 | 755 | 448 |
| Y-100 (A3) | 29-Sep-07 | 82.56 | 6996.95 | --- | --- | --- | --- |
| Y-100 (A3) | 18-Jun-08 | 83.59 | 6995.92 | --- | --- | --- | --- |
| Y-100 (A3) | 20-Aug-08 | 83.69 | 6995.82 | --- | --- | --- | --- |
| Y-100 (A3) | 22-Apr-10 | 88.28 | 6991.23 | --- | --- | --- | --- |
| Y-100 (A3) | 8-Sep-11 | 78.05 | 7001.46 | --- | --- | --- | --- |
| Y-100 (A3) | 23-Dec-11 | 76.90 | 7002.61 | --- | --- | --- | --- |
| Y-100 (A3) | 30-Mar-12 | 78.06 | 7001.45 | --- | --- | --- | --- |
| Y-100 (A3) | 13-Dec-12 | 82.55 | 6996.96 | --- | --- | --- | --- |
| Y-100 (A3) | 2-Jun-13 | 84.02 | 6995.49 | --- | --- | --- | --- |
| Y-100 (A3) | 29-Sep-13 | 86.32 | 6993.19 | --- | --- | --- | --- |
| Y-100 (A3) | 19-Dec-13 | 86.69 | 6992.82 | --- | --- | --- | --- |
| Y-100 (A3) | 30-Mar-14 | 86.56 | 6992.95 | --- | --- | --- | --- |
| Y-100 (A3) | 16-Jun-14 | 86.64 | 6992.87 | --- | --- | --- | --- |
| Y-100 (A3) | 29-Sep-14 | 88.10 | 6991.41 | --- | --- | --- | --- |

| Site | Date | W.L. (feet below toc) | | T | pH | Cond | TDS |
|---|---|---|---|---|---|---|---|
| Y-101 (A4) | 2-Jul-87 | --- | 6993.60 | 10 | 7.25 | 965 | --- |
| Y-101 (A4) | 4-Aug-87 | --- | 6993.30 | 10 | 7.25 | 1045 | --- |
| Y-101 (A4) | 16-Sep-87 | --- | 6993.06 | 10.1 | 7.05 | 985 | 594 |
| Y-101 (A4) | 27-Oct-87 | --- | 6993.00 | 10 | 7 | 1170 | --- |
| Y-101 (A4) | 15-Nov-87 | --- | 6993.00 | 8.4 | 7.20 | 980 | --- |
| Y-101 (A4) | 9-Dec-87 | --- | 6992.94 | 9.0 | 7.00 | 965 | 582 |
| Y-101 (A4) | 5-Jan-88 | --- | 6992.90 | 8.2 | 7.10 | 920 | --- |
| Y-101 (A4) | 16-Feb-88 | --- | 6992.60 | 8.5 | 7.30 | 910 | --- |
| Y-101 (A4) | 18-Mar-88 | --- | 6992.63 | 9.0 | 7.10 | 935 | 598 |
| Y-101 (A4) | 23-Dec-11 | 27.94 | 6988.85 | --- | --- | --- | --- |
| Y-101 (A4) | 30-Mar-12 | 27.33 | 6989.46 | --- | --- | --- | --- |
| Y-101 (A4) | 13-Dec-12 | 29.37 | 6987.42 | --- | --- | --- | --- |
| Y-101 (A4) | 2-Jun-13 | 30.48 | 6986.31 | --- | --- | --- | --- |
| Y-101 (A4) | 29-Sep-13 | 32.01 | 6984.78 | --- | --- | --- | --- |
| Y-101 (A4) | 19-Dec-13 | 32.32 | 6984.47 | --- | --- | --- | --- |
| Y-101 (A4) | 30-Mar-14 | 32.33 | 6984.46 | --- | --- | --- | --- |
| Y-101 (A4) | 16-Jun-14 | 32.85 | 6983.94 | --- | --- | --- | --- |
| Y-101 (A4) | 29-Sep-14 | 33.59 | 6983.20 | --- | --- | --- | --- |

CDM

# BOREHOLE LOG RECORD

Project: Alton Coal
No. 8448-111
Q.A. No. F6132
By: L.L. Osen  Date: 7/9/86
Page 1 of 2
Rev.
Chkd By
Date
Page ___ of ___

Project ID*
Hole No.* A 3
Record Type: B L R
Site No.*
Date*
Time*
Twsp
Rng
Sec
1/4
1/4
1/4
Location N
E
SR. EL.* FT / M
Survey Elevation FT / M

Contractor: MOTE
Driller: John
Rig: Failing 1500
Bit(s): 5-7/8" Tricone
Core: None
Fluid: Dry to 27'; Mud
Borehole Diameter(s)
Total Depth: 131'
Geophysical Log: Yes X  No ___
Date: St ___ Fn ___
Status

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 0-5' | | SM | Silty fine grained sand, brown, 1% pebble |
| | | | gravel, 5% clay |
| 5-10' | ... | SM-ML | Silty fine grained, sand, brown; pebble gravel |
| | | | Gravel (2%); sandy silt, reddish brown, |
| | | | (10%); clay (5%) |
| 10-15' | | CL | Clay, silty, sandy, brown (95%); clay, |
| | | | silty (5%); v. little pebble gravel |
| 15-20' | | CL | Sand, silty, clayey, brown; v. little pebble |
| | | | gravel |
| 20-25' | | SM-SC | V. fine grained sand, silty, clayey, brown (50%); |
| | | | clayey silt; brown (50%); v. little pebble |
| | | | gravel |
| 25-30' | | SM-SC | Silty fine grained sand, brown; v. little |
| | | | pebble gravel; trace amt of clay; |
| | | | trace amount of what appears to be white |
| | | | v. fine grained sand |
| 30-35' | | GM-GC | Pebble gravel, angular (98%), semi-rounded |
| | | | (2%); silty f. grained sand, tan (25%) |
| 35-40' | | GM-GC | SAA - Slightly more pebble gravel |
| 40-50' | | GM-GC | Sandy silt, tan (50%); pebble gravel |
| | | | angular (50%); trace amount of |
| | | | organic (carbonaceous) material |
| 50-55' | | | Silty fine grained sand, tan (50%); |
| | | | pebble gravel (50%); trace amount of clay |
| 55-65' | | GM-GC | SAA |
| 65-70' | | GM-SM | Silty fine grained sand, brown (70%); pebble gravel |
| | | | (30%) |
| | | | |
| | | | |

* SEE EXPLANATIONS ON BACK

Q.C. ________

CDM

# BOREHOLE LOG RECORD (cont) (A3)

Project Alton Coal
By L.L. Osen Date 7/9/86
Chkd By
No. 8448-111
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Date
Q.A. No. F0132
Rev.
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| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 70-75' | | GM-SM | SAA |
| 75-120' | | GM-SM | SAA; Trace clay |
| 120-131' | | GM-SM | SAA; approximately 5% more silty sand |

* SEE EXPLANATIONS ON BACK

Q.C.

CDM

# BOREHOLE LOG RECORD

Project Alton Coal No. 8448-111 Q.A. No. F6132
By L.L. Osen Date 7/11/86 Page 1 of 2 Rev.
Chkd By Date Page of

Project ID* Hole No.* A 4
Record Type B L R Site No.* Date* Time*
Twsp Rng Sec 1/4 1/4 1/4
Location N E
SR. EL.* FT M Survey Elevation FT M

Contractor MOTE Driller John Rig Failing 1500
Bit(s) 5-7/8" Tricone Core None Fluid Dry to 15' Revert @15'
Borehole Diameter(s) Total Depth
Geophysical Log: Yes No Date: St Fn Status

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 0-5' | | SM | Silty sand, brown, fine grained, slightly |
| | | | cohesive, dry |
| 5-10' | ... | SM | SAA, slightly more cohesive |
| 10-15' | | SM-SC | SAA, hit gravel at 14', trace clay |
| | | | |
| | | | Started drilling with mud |
| | | | |
| 15-20' | | GM-GC | Pebble gravel, large pebbles angular, probably due |
| | | | to breakage; some smaller pebbles are rounded to |
| | | | subangular; 1.5% silty sand, 0.5% silty clay |
| 20-25' | | GM-GC | Pebble gravel, SAA, 3% clay, 2% silt |
| 25-30' | | GM-GC | Pebble gravel, SAA, 5% brown silty fine-grained |
| | | | sand, 5% clay |
| 30-35' | | GM-GC | Pebble gravel, SAA, 10% brown sandy, clayey silt |
| 35-40' | | GM-GC | Pebble gravel, SAA, 5% brown silty sand with very |
| | | | little clay |
| 40-45' | | GM-GC | Pebble gravel, SAA, 3% brown, very fine grained |
| | | | sandy silty clay, 2% brown sandy silt |
| 45-50' | | CH | Clay, grayish brown, silty, 5% pebble gravel. |
| | | | Driller noted clay layer @ 43-49' (looks like |
| | | | Tropic Shale slopewash) |
| @ 49' | | | Started losing water |
| 50-55' | | GM-GC | Pebble gravel, 2% brown clayey silty sand |
| 55-60' | | GM-GC | Pebble gravel, 1% brown clayey silty sand, 1% brown |
| | | | silty sandy clay |
| | | | |
| | | | |
| | | | |

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Q.C.

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NOV 19 2015

Div. of Oil, Gas & Mining

CDM

# BOREHOLE LOG RECORD (cont) (A4)

Project: Alton Coal
By: L.L. Osen  Date: 7/11/86
Chkd By:
No. 8448-111
Page 2 of 2
Date:
Q.A. No. F6132
Rev.
Page  of

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 60-65' | | GM-GC | Pebble gravel, 5% brown sandy clayey silt |
| 65-70' | | GM-GC | Pebble gravel, 5% silty, clayey fine-grained sand |
| 70-75' | | | SAA |
| 75-80' | | GM-GC | Pebble gravel, 3% brown silty sand, 2% brown silty |
| | | | clay - looks like Tropic Shale |
| 80-84' | | GM-GC | 50% pebble gravel; 50% gray silty clay (Tropic |
| | | CL | Shale) |

* SEE EXPLANATIONS ON BACK

Q.C.

CDM

# BOREHOLE LOG RECORD

Project Alton Coal
By L.L. Osen Date 7/11/86
Chkd By
No. 8448-111
Page 1 of 1
Date
Q.A. No. F6132
Rev.
Page of

Project ID* Hole No.* A 2
Record Type B L R Site No.* Date* Time*
Twsp Rng Sec 1/4 1/4 1/4
Location N E
GR. EL.* FT M Survey Elevation FT M

Contractor MOTE Driller John Rig Failing 1500
Bit(s) 5-7/8" Tricone Core None Fluid None
Borehole Diameter(s) Total Depth 22'
Geophysical Log: Yes __ No X Date: St 7/9 Fn 7/9 Status

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 0-10' | | SM-SC | Silty fine grained sand, brown, weathered, dry (60%); pebble gravel, angular to sub-rounded; matrix is slightly moist, cohesive |
| 10-15' | | SM-SC | Silty fine grained sand, brown (95%), pebble gravel angular to sub-rounded: trace sandy, clayey silt chunks, dry. |
| 15-20' | | SM-SC | Silty fine grained sand, brown (50%); clay, hard grayish brown, (50%), dry. |
| 20-22' | | CL | Silty claystone, grayish brown, Tropic Shale, dry. |

* SEE EXPLANATIONS ON BACK

Q.C.

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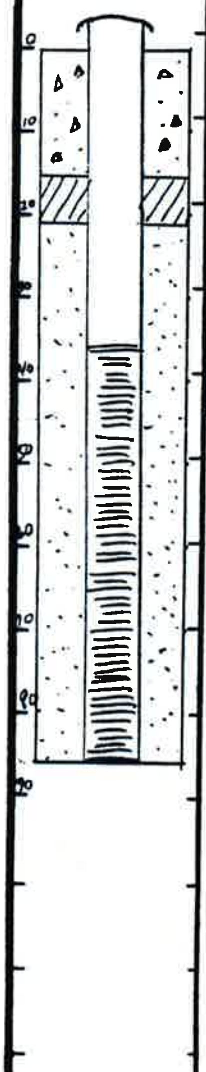
# WELL CONSTRUCTION SUMMARY

Project UI - Alton Coal  No. 8448-111
By L.L. Osen  Date 7/9/86  Page 1 of 1
Chkd By  Date

Q.A. No. F6216
Rev.
Page  of

Project ID*  Well No.* A 1
Record Type W C S  Site No.*  Date*  Time*
Tnsp  Rng  Sec  1/4  1/4  1/4
Location N  E
SR. EL.* FT/M  Survey Elevation FT/M

PERSONNEL L.L. Osen/Dave Tabet DEU  TOP OF CASING ELEVATION



## DRILLING SUMMARY

Total Depth 86'
Borehole Diameter From 0 to 86' 5-7/8"
Driller John Grubelnik of MO-TE
Rig Failing 1500
Bit(s) Tricone
Drilling Fluids From 0 to 86' Mud (Revert)
Surface Casing From  to

## CONSTRUCTION TIME LOG

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling 0-40' | 7/8 | | | 1700 |
| 40-86' | 7/9 | 0800 | 7/9 | |
| Geophysical Logging | 7/9 | | 7/9 | |
| Casing | 7/9 | | 7/9 | |
| Filter Placement | 7/9 | | 7/9 | |
| Cementing | 7/9 | | 7/9 | |
| Development | 7/19 | 1230 | 7/19 | 1300 |
| Other Devel-opment | 7/19 | 1755 | 7/19 | 1935 |

## WELL DESIGN

Basis: Geologic Log X
Geophysical Log

Casing String(s): C-Casing S-Screen

+2.99-36.63' C1  36.63-86.0' S1

## CONSTRUCTION DESCRIPTION

Casing: C1 2" SCH 80 PVC
C2
C3
C4
Screen: S1 2" SCH 80 PVC
S2
S3
S4
Centralizers N/A

Filter Material Silica Sand (10-20) 21'-86' (10-100# bags)
Cement 0-15.5' (2.5-96 lb sacks/5 Gal. $H_2O$)
Slot Sizes .010 Slot
Other 15.5'-21' - Bentonite Pellet Seal (1-5 Gal. Bucket)

* SEE EXPLANATIONS ON BACK

Q.C.

# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT**

7/9/86 -- As much mud (revert) as possible was flushed out of the hole.
7/19/86 -- (see development notes)
-- 1230-1300 -- Tried using air compressor. Looks like we only blew air through screen.
-- 1755-1925 -- Bailed well -removed 15 gal - Bailed to EC & pH stability

**COMMENTS** Another drill hole 20' from this hole -- 0-42' -- Filled with cuttings & cement. Water level dropped significantly after using air compressor on well (see notes).

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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PROJECT ID – Two Letter Designation
WELL NO. – Four Character Alphanumeric Designation
SITE NO. – Four Character Alphanumeric Designation

DATE – Yr, Yr, Mo, Mo, Day, Day
TIME – Military
SR. EL. – Surface Elevation

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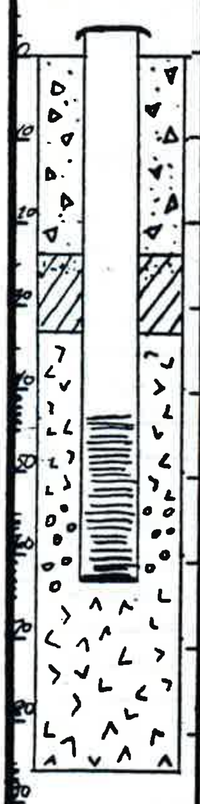
environmental engineers, scientists, planners & management consultants

# WELL CONSTRUCTION SUMMARY

Project UI - Alton Coal  No. 8448-111  Q.A. No. F6216
By L.L. Osen  Date 7/30/86  Page 1 of 1  Rev. ______
Chkd By ______  Date ______  Page ______ of ______

Project ID* ______  Well No.* A 5
Record Type W C S  Site No.* ______  Date* ______  Time* ______
Tnsp ______  Rng ______  Sec ______  1/4 ______  1/4 ______  1/4 ______
Location N ______  E ______
SR. EL.* ______ FT/M  Survey Elevation ______ FT/M

PERSONNEL L. Osen/G. Shaughnessy  TOP OF CASING ELEVATION ______



## DRILLING SUMMARY

Total Depth 86'
Borehole Diameter From 0 to 86' = 5-7/8"
Driller John Grubelnik from MO-TE
Rig Failing 1500
Bit(s) 5-7/8" Tricone
Drilling Fluids From 0 to 86'
6 bags barite/4 bags revert
Surface Casing From ______ to ______

## CONSTRUCTION TIME LOG

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 7/11 | | 7/11 | |
| Geophysical Logging | 7/11 | | 7/11 | |
| Casing | 7/11 | | 7/11 | |
| Filter Placement | 7/11 | | 7/11 | |
| Cementing | 7/11 | | 7/11 | |
| * Development | 7/11 | | 7/12 | |
| Other | | | | |

## WELL DESIGN

Basis: Geologic Log X
Geophysical Log X

Casing String(s): C-Casing S-Screen

+2.8'-43.7' C1  43.7 -62.94 S1

## CONSTRUCTION DESCRIPTION

Casing: C1 2" SCH 80 PVC
C2 ______
C3 ______
C4 ______

Screen: S1 2" SCH 30 PBC
S2 ______
S3 ______
S4 ______

Centralizers N/A

Filter Material Pea gravel/material caving in hole 32'-62.9'

Cement Barite mix - 0-24'. 10 - 96# sacks cement; 3 - 100# bags Barite; 35 Gal H20

Slot Sizes .010 Slotted

Other Hole bridged at 62.9' -- Ran casing down to bridge; *Hole bridged solid at 32' Bentonite pellet seal 24'-32'

* SEE EXPLANATIONS ON BACK

Q.C. ______

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# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT** The well was self-developing. The well was left uncapped and flowed overnight at a rate of approximately 10-15 GPM after initially flowing at 15-20 GPM when well installed; water is clear.

**COMMENTS** Managed to get pea gravel tagged to 56' -- with 8 more gallons of pea gravel, the materials in hole were tagged at 32' -- The hole bridged again -- a solid bridge on all sides of the well casing -- Bentonite seal put on top of bridge.

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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PROJECT ID – Two Letter Designation
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SITE NO. – Four Character Alphanumeric Designation
DATE – Yr, Yr, Mo, Mo, Day, Day
TIME – Military
SR. EL. – Surface Elevation

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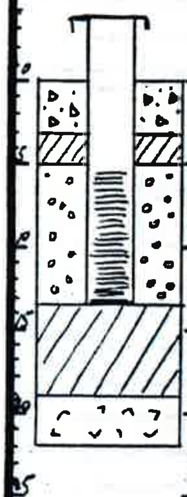
environmental engineers, scientists, planners, & management consultants

# WELL CONSTRUCTION SUMMARY

Project UI - Alton Coal  No. 3448-111  Q.A. No. F8216
By LLO  Date 7/9/86  Page 1 of 1  Rev. ______
Chkd By ______  Date ______  Page ______ of ______

Project ID* ______  Well No.* A 2
Record Type W C S  Site No.* ______  Date* ______  Time* ______
Tnsp ______  Rng ______  Sec ______  1/4 ______  1/4 ______  1/4 ______
Location N ______  E ______
SR. EL.* ______ FT/M  Survey Elevation ______ FT/M



PERSONNEL L L Osen  TOP OF CASING ELEVATION ______

## DRILLING SUMMARY

Total Depth 22'
Borehole Diameter From 0 to 22' = 5-7/8"
Driller John Grubelnik
Rig Failing 1500
Bit(s) 5-7/8" Tricone
Drilling Fluids From ______ to ______
None - Drilled dry
Surface Casing From ______ to ______

## WELL DESIGN

Basis: Geologic Log X
Geophysical Log ______
Casing String(s): C-Casing S-Screen

| Casing | | Screen | |
|---|---|---|---|
| +3.81-5.09 | C1 | 5.09-13.2 | S1 |

## CONSTRUCTION TIME LOG

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 7/9 | | 7/9 | |
| Geophysical Logging N/A | | | | |
| Casing | 7/9 | | 7/9 | |
| Filter Placement | 7/9 | | 7/9 | |
| Cementing | 7/9 | | 7/9 | |
| Development | | | | |
| Other Dry - see Comments | 7/19 | | 7/19 | |

## CONSTRUCTION DESCRIPTION

Casing: C1 2" Sch 80 PVC
C2 ______
C3 ______
C4 ______
Screen: S1 2" Sch 80 PVC
S2 ______
S3 ______
S4 ______
Centralizers N/A
Filter Material 5'-13.2' - Pea Gravel (40 gals)
Cement 0-3'; ¼ - 96 lb sack 2.5 Gal. $H_2O$
Slot Sizes .010 Slot
Other Bentonite seal #1 13.2'-19' (5 gal pellet
Bentonite seal #2 3'-5' (1.6 g[illegible] pellet
Cuttings - 19'-22' (sloughed material from sides of borehole.)

* SEE EXPLANATIONS ON BACK

Q.C. ______

# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT** 7/19/86 - Well had residual water -- 0.63' of screened section was unslotted therefore water in well should only be that that was poured on top of Bentonite for wetting the Bentonite pellets.

**COMMENTS**

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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PROJECT ID - Two Letter Designation
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SITE NO. - Four Character Alphanumeric Designation

DATE - Yr, Yr, Mo, Mo, Day, Day
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SR. EL. - Surface Elevation

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# WELL CONSTRUCTION SUMMARY

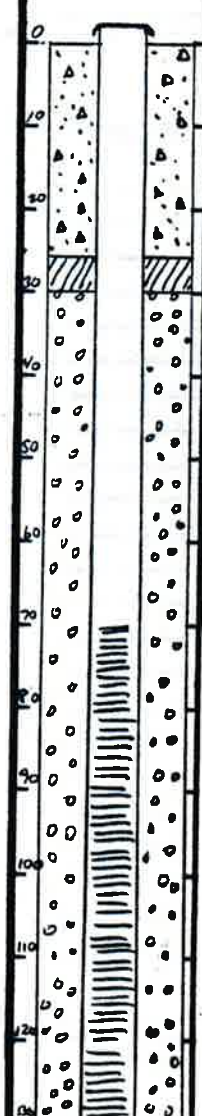
Project UI - Alton Coal
By L.L. Osen  Date 7/10/86
Chkd By ______

No. 8448-111
Page 1 of 1
Date ______

Q.A. No. F6216
Rev. ______
Page ______ of ______

Project ID* ______  Well No.* A 3
Record Type W C S  Site No.* ______  Date* ______  Time* ______
Tnsp ______  Rng ______  Sec ______  1/4 ______  1/4 ______  1/4 ______
Location N ______  E ______
SR. EL.* ______ FT / M  Survey Elevation ______ FT / M

PERSONNEL L.L. Osen  TOP OF CASING ELEVATION ______



## DRILLING SUMMARY

Total Depth 131'
Borehole Diameter From 0 to 131' = 5-7/8"
Driller John Grubelnik from MO-TE
Rig Failing 1500
Bit(s) 5-7/8" Tricone
Drilling Fluids From 0 to 131' Johnson Revert (3 bags)
Surface Casing From ______ to ______

## CONSTRUCTION TIME LOG

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 7/10 | 1115 | 7/10 | |
| Geophysical Logging | 7/10 | | 7/10 | |
| Casing | 7/10 | | 7/10 | |
| Filter Placement | 7/10 | | 7/10 | |
| Cementing | 7/10 | | 7/10 | 1710 |
| Development | 7/19 | 1040 | 7/19 | 1210 |
| Other | | | | |

## WELL DESIGN

Basis: Geologic Log X
Geophysical Log ______
Casing String(s): C-Casing S-Screen

+2.5 - 70.10 C1  70.10 - 130.59 S1

## CONSTRUCTION DESCRIPTION

Casing: C1 2" SCH 80 PVC
C2 ______
C3 ______
C4 ______
Screen: S1 2" SCH 80 PVC
S2 ______
S3 ______
S4 ______
Centralizers N/A
Filter Material Pea Gravel 29.5'-131' (102.5 Gal.)
Cement 0-26' - 3-96# Sacks 15 Gal. $H_2O$
Slot Sizes .010 Slotted
Other Bentonite seal - 26-29.5' (3 Gal. of Pellets + 5 Gal. $H_2O$ to wet)

* SEE EXPLANATIONS ON BACK

Q.C. ______

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# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT** Used an air compressor to blow water out of the well at a rate of 1-2 GPM for 35 minutes (see well development notes). Was still some v. fine sand coming out of hole; pH and EC had stabilized; water level before & after development ~ the same.

**COMMENTS** While doing the well completion, the drillers flushed out as much revert as possible. At the end of drilling, the mud (revert) was fairly watered down anyway. Due to limit on number of bags available for the hole.

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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PROJECT ID – Two Letter Designation
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SR. EL. – Surface Elevation

# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT** 7/19/86 -- See well development notes; let air compressor run for 55 minutes -- blowing water out of the casing at a rate of 2-5 GPM (varied over time) -- The well was extremely well developed.

**COMMENTS**

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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**WELL NO.** – Four Character Alphanumeric Designation
**SITE NO.** – Four Character Alphanumeric Designation
**DATE** – Yr, Yr, Mo, Mo, Day, Day
**TIME** – Military
**SR. EL.** – Surface Elevation

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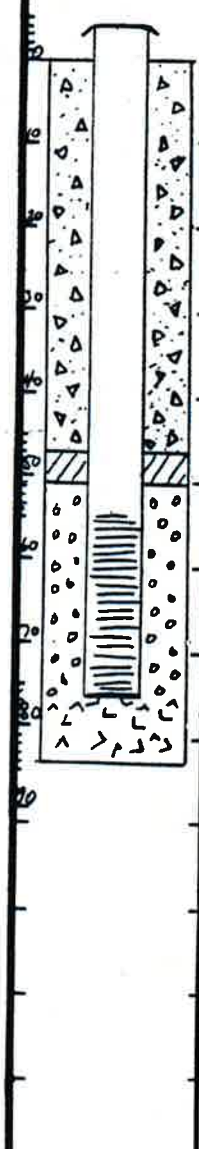
# WELL CONSTRUCTION SUMMARY

Project UI - Alton Coal No. 8448-111
By L.L. Osen Date 7/11/86 Page 1 of 1
Chkd By ______ Date ______

Q.A. No. F6216
Rev. ______
Page ______ of ______

Project ID* ______ Well No.* A 4
Record Type W C S Site No.* ______ Date* ______ Time* ______
Tnsp ______ Rng ______ Sec ______ 1/4 ______ 1/4 ______ 1/4 ______
Location N ______ E ______
SR. EL.* ______ FT / M Survey Elevation ______ FT / M



PERSONNEL L.L. Osen
TOP OF CASING ELEVATION ______

**DRILLING SUMMARY**

Total Depth 84'
Borehole Diameter From 0 to 84' = 5-7/8"
Driller John Grubelnik From MO-TE
Rig Failing 1500
Bit(s) 5-7/8" Tricone
Drilling Fluids From 15' to 84' Revert
Surface Casing From ______ to ______

**WELL DESIGN**

Basis: Geologic Log X
Geophysical Log ______
Casing String(s): C-Casing S-Screen

| | | | |
|---|---|---|---|
| +3.46-54.49' | C1 | 54.49-76.64' | S1 |

**CONSTRUCTION TIME LOG**

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | 7/11 | | 7/11 | |
| Geophysical Logging | 7/11 | | 7/11 | |
| Casing | 7/11 | | 7/11 | |
| Filter Placement | 7/11 | | 7/11 | |
| Cementing | 7/11 | | 7/11 | |
| Development | 7/19 | | 7/19 | |
| Other | | | | |

**CONSTRUCTION DESCRIPTION**

Casing: C1 2" SCH 80 PVC
C2 ______
C3 ______
C4 ______
Screen: S1 2" SCH 80 PVC
S2 ______
S3 ______
S4 ______
Centralizers N/A
Filter Material Pea Gravel 50.6'-77.6'
Cement 0-47'
Slot Sizes .010 Slotted
Other Bridge formed at 77.6'-- Could not get past with pipe -- Bentonite Pellet Seal 47-50.6'

* SEE EXPLANATIONS ON BACK

Q.C. ______

# WELL CONSTRUCTION SUMMARY

**WELL DEVELOPMENT** 7/19/86 -- See well development notes; let air compressor run for 55 minutes -- blowing water out of the casing at a rate of 2-5 GPM (varied over time) -- The well was extremely well developed.

**COMMENTS**

## WELL CONSTRUCTION ACCOUNTING SUMMARY

| ITEM | SIZE | QNTY | UNIT | BID COST | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|
| Borehole Drilling | | | | | | |
| Casing (blank) | | | | | | |
| Casing (slotted) | | | | | | |
| Casing Install. | | | | | | |
| Filter Pack | | | | | | |
| Filter Install. | | | | | | |
| Bentonite Pellets | | | | | | |
| Pellet Install. | | | | | | |
| Grout | | | | | | |
| Grout Install. | | | | | | |
| Borehole Plug | | | | | | |
| Plug Install. | | | | | | |
| Protect. Casing | | | | | | |
| Casing Install. | | | | | | |
| Well Development | | | | | | |
| Site Clean-up | | | | | | |
| Aux. Air | | | | | | |
| Back-hoe | | | | | | |
| Standby (spec.) | | | | | | |
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**PROJECT ID – Two Letter Designation**
**WELL NO. – Four Character Alphanumeric Designation**
**SITE NO. – Four Character Alphanumeric Designation**

**DATE – Yr, Yr, Mo, Mo, Day, Day**
**TIME – Military**
**SR. EL. – Surface Elevation**

CDM

# BOREHOLE LOG RECORD

Project UI - Alton Coal No. 8448-111 Q.A. No. F6132
By L.L. Osen-JGS Date 7/12/86 Page 1 of 2 Rev.
Chkd By Date Page of

Project ID* Hole No.* A 5
Record Type B L R Site No.* Date* Time*
Tnsp Rng Sec 1/4 1/4 1/4
Location N E
SR. EL.* FT M Survey Elevation FT M

Contractor MOTE Driller John Rig Failing 1500
Bit(s) 5-7/8" Tricone Core Fluid Revert/Barite @ 0' @ 42'
Borehole Diameter(s) Total Depth
Geophysical Log: Yes__ No __ Date: St 7/11 Fn __ Status

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| | | 7/12/86 | Arrived on site @ 0815, had already drilled |
| | | | from 42' - 77' |
| 0'-5' | ... | CL-ML | Clay, brown to gray trace of black, silty with |
| | | | minor sand sub rnded gravel to 1/8" |
| 5'-10' | | SC-CL | Sand, light gray, very fine to fine, with some clay |
| | | | alternating with clay, tan, silty, minor coarse |
| | | | sand & trace of ang. clinker gravel to 1/8" |
| 10-15' | | CL-SP | Clay, gray-brown, with some silt and trace of |
| | | SC | Sand embedded in it with interbeds of sand, |
| | | | orange, very fine to medium grained. |
| | | SC-SP | With localy clayey zones, brown to gray |
| 15-20' | | | SAA, with traces of black, organic material (CL-OL) |
| | | | Mostly increasing clayey sand |
| 20-25 | | SC-SP | SAA, no organic material observed |
| | | a CL | Minor gravel to 1/2", sub ang. |
| 25-30 | | | SAA |
| 30-35 | | | SAA with increasing gravel, subang. to subround |
| | | | to 3/4" |
| 35-40' | | | SAA, grayer color, decreasing gravel |
| 40-45' | | GP-CG | Clay, gray, silty to sandy, with traces of organic |
| | | SC-CL | material with gravel, to 1", subround comprised |
| | | | of clinker material |
| 45-50' | | GP-GC | Sand brown to orange, very fine to mg, clayey |
| | | SC | with gravel as above |
| 50-55' | | | With interbeds of clay, dark gray, possibly |
| | | | organic (CL-OL) |
| 55-60' | | | SAA with increasing gravel to 3/4" |
| | | | |

* SEE EXPLANATIONS ON BACK

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CDM

# BOREHOLE LOG RECORD (cont) (A5)

Project Utah Int.-Alton Coal    No. 8448-111
By JGS    Date 7/12/86    Page 2 of 2
Chkd By    Date

Q.A. No. F6132
Rev.
Page    of

| Depth (ft) | Air Lift (Q) | Symbol | Material Description and Comments |
|---|---|---|---|
| 60-65' | | GP-GC | Gravel, brown to red, up to 3/4", subrounded to |
| | | SC | subang. Some possibly larger with interbeds |
| | | | of sand, very fine to medium, gray to brown color |
| 65-70' | | | SAA decreasing clay |
| | | | |
| 70-75' | | GP-SP | Mostly gravel, little clay recovered up to 1-1/2" |
| | | | with pebbles of black chert. Probably with |
| | | | sand, fine to coarse grained, tan and slightly |
| | | | silty to clayey (little recovered) 71-77' |
| 75-80' | | | SAA |
| 80-83' | | | SAA |
| 83-85' | | | Claystone, dark grey, slightly silty. Top of |
| | | | bedrock, (Tropic Shale) |
| 85-86' | | | Same as 83-85' |
| | | | |
| | | | 6 bags of barite & 4 bags of revert used |
| | | | in the hole |

* SEE EXPLANATIONS ON BACK

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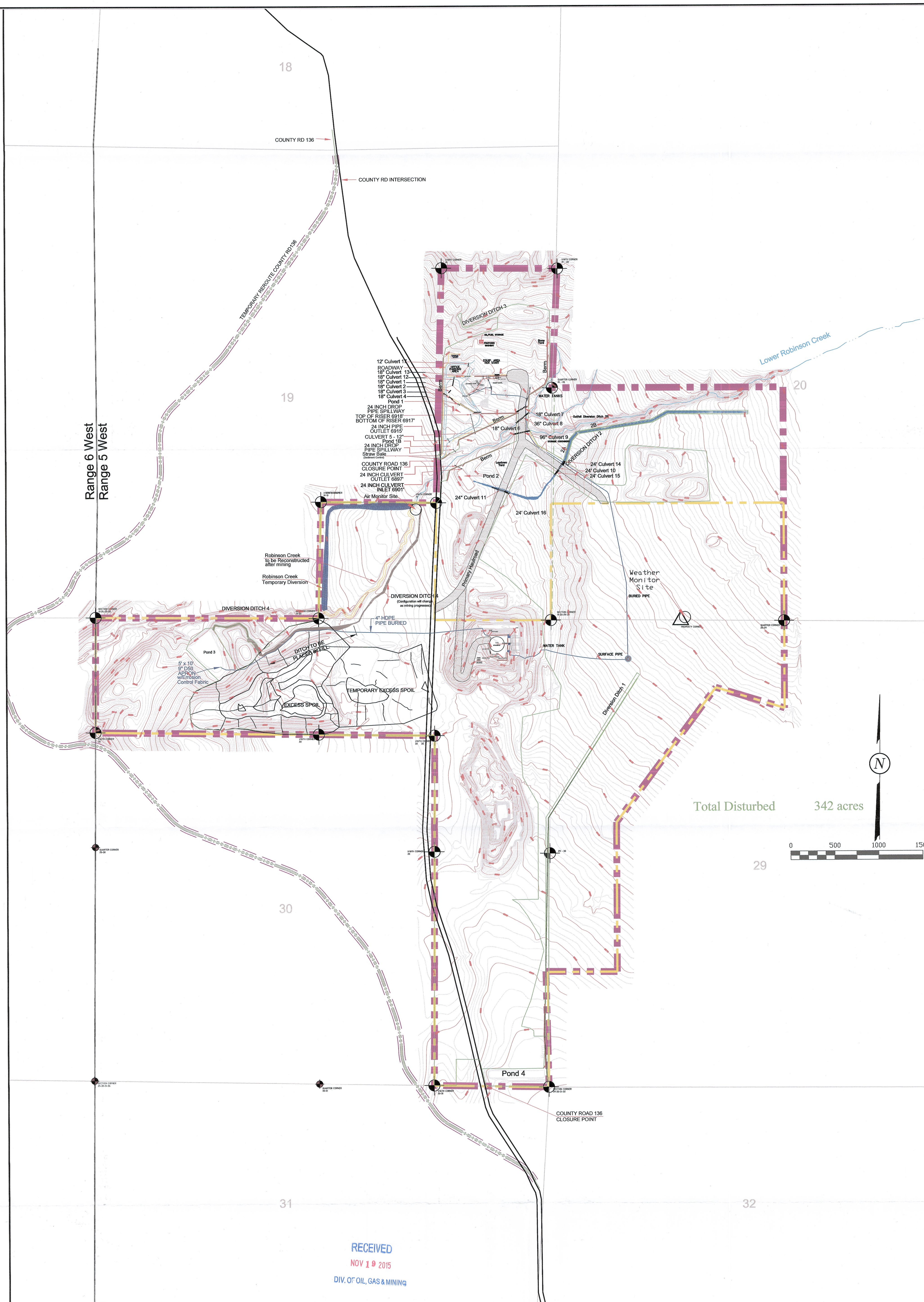


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| LEGEND: | DRAWN BY: | CHECKED BY: | REVISIONS | | FACILITIES & STRUCTURES LAYOUT |
|---|---|---|---|---|---|
| PERMIT BOUNDARY | C. McCOURT<br>G. Grossman | CRM/WES | DATE: | BY: | COAL HOLLOW PROJECT<br>ALTON, UTAH |
| PRIVATE COAL OWNERSHIP | DRAWING: | DATE: | 6/13/11 | KN/JKJR | DRAWING: 5-3 |
| COAL RECOVERY LINE | 5-3 | 11/10/08 | 9/28/15 | KN | |
| SECTION LINE | | SCALE: | | | |
| FOUND SECTION CORNER | | 1" = 500' | | | |
| FOUND PROPERTY CORNER | JOB NUMBER: | SHEET | | | |
| DIVERSION DITCHES | 1400 | | | | |
| PROPOSED SEDIMENT IMPOUNDS | | | | | |
| BERM | | | | | |
| YEAR 1 DISTURBANCE | | | | | |
| YEAR 2 DISTURBANCE | | | | | |
| YEAR 3 DISTURBANCE | | | | | |
| CENTERLINE | | | | | |
| WATER LINE | | | | | |
| WATER TANK / WELL | | | | | |

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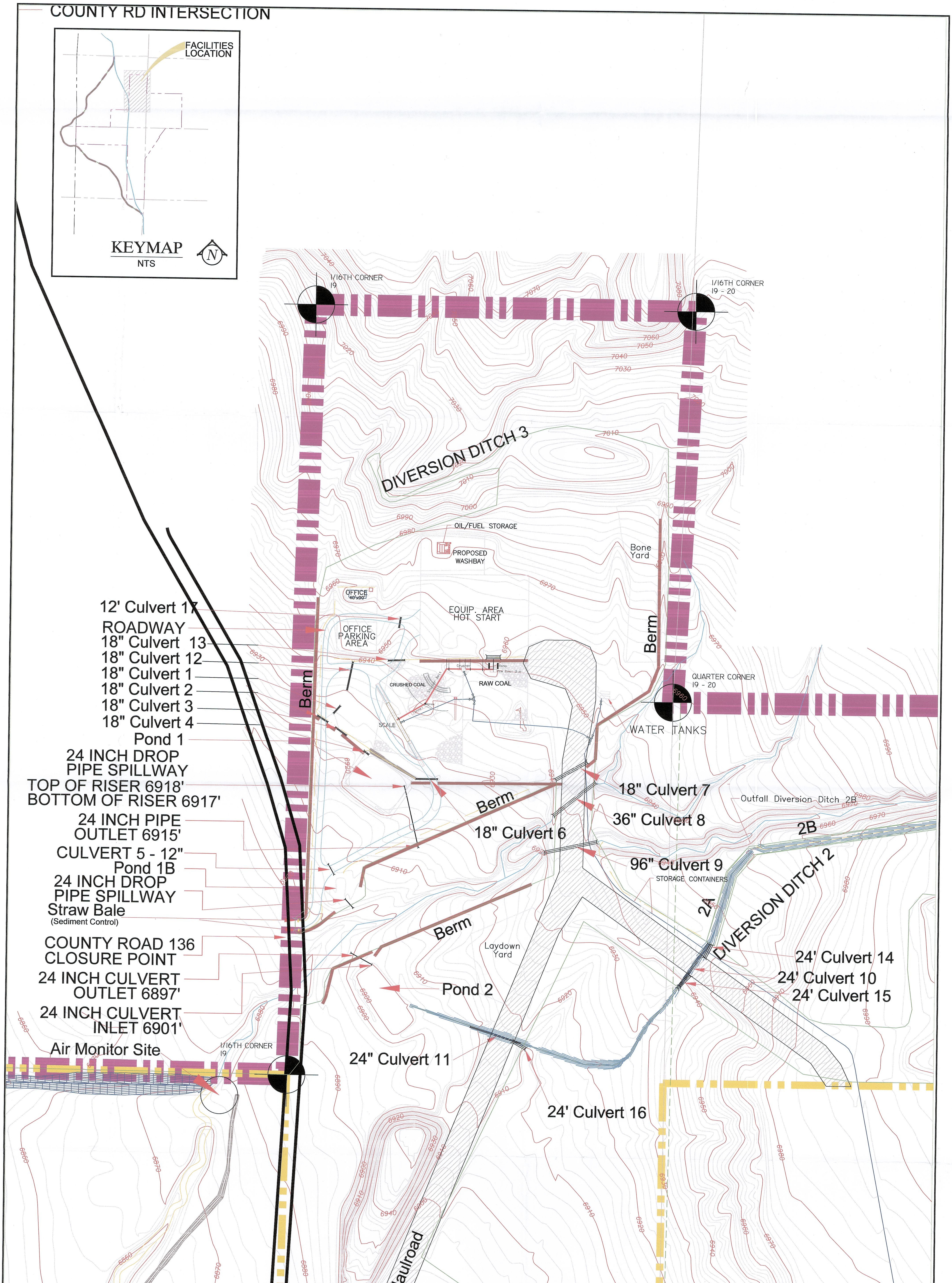
UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY 11/17/15


Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435) 867-5331
Fax (435) 867-1192




LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- COAL RECOVERY LINE
- SECTION LINE
- DRAINAGE DITCH
- DIVERSION DITCHES

| DRAWN BY: C. McCOURT, G. Grossman | CHECKED BY: LWJ |
|---|---|
| DRAWING: 5-3A | DATE: 11/10/08 |
| | SCALE: 1" = 500' |
| JOB NUMBER: 1400 | SHEET |

**REVISIONS**

| DATE: | BY: |
|---|---|
| 6/13/11 | KN/JKJR |
| 09/28/15 | KN |
| | |
| | |
| | |

# FACILITIES & STRUCTURES

## CULVERTS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-3A

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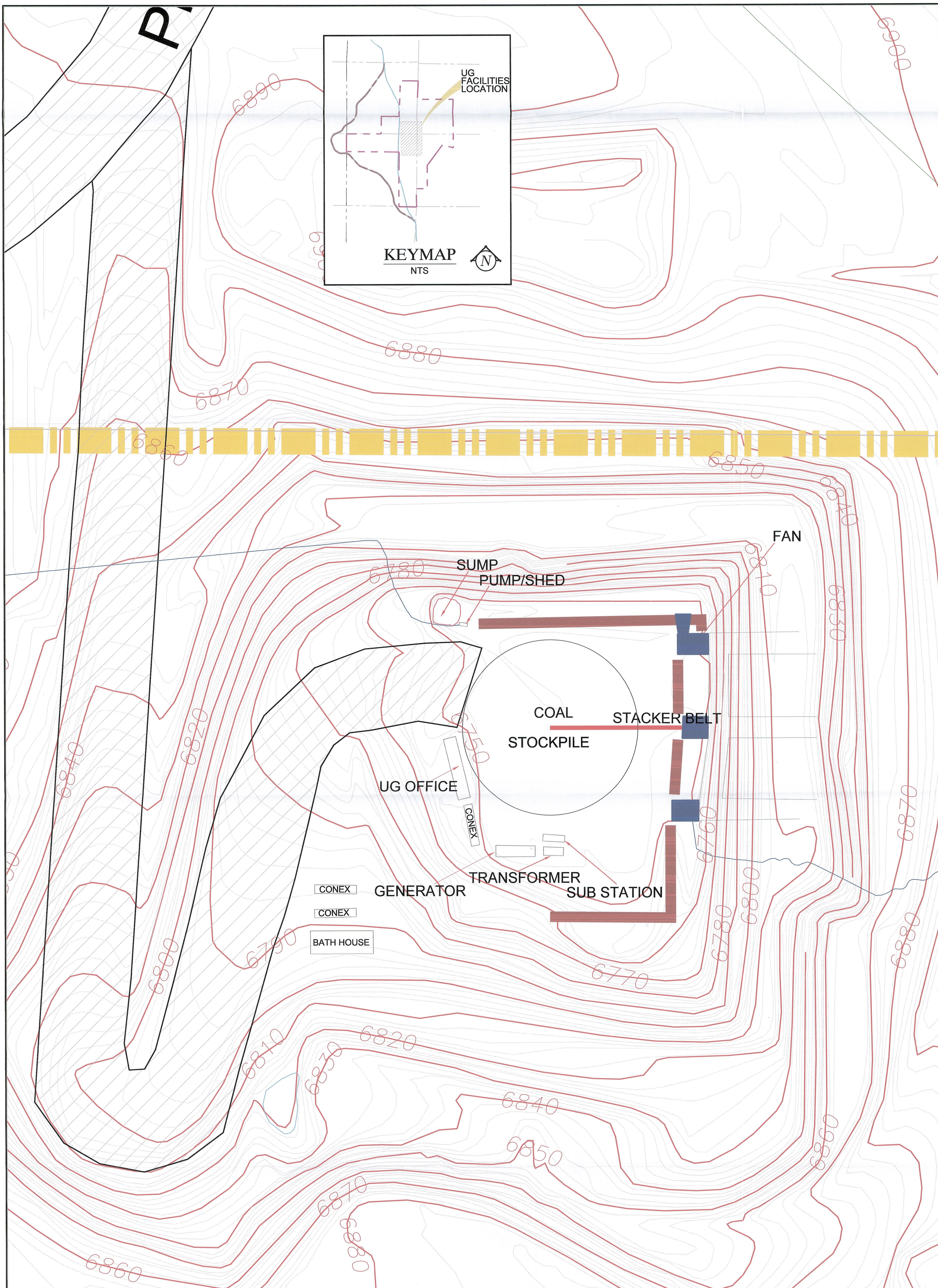


LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- COAL RECOVERY LINE
- SECTION LINE
- DRAINAGE DITCH
- DIVERSION DITCHES

| | |
|---|---|
| DRAWN BY: K. NICHOLES | CHECKED BY: LWJ |
| DRAWING: 5-3B | DATE: 06/13/11 |
| | SCALE: 1" = 500' |
| JOB NUMBER: 1400 | SHEET |

**REVISIONS**

| DATE: | BY: |
|---|---|
| 6/13/11 | KN/JKJR |
| 09/28/15 | KN |
| | |
| | |
| | |
| | |

# UNDERGROUND FACILITIES & STRUCTURES

## LAYOUT

COAL HOLLOW PROJECT
ALTON, UTAH

**DRAWING: 5-3B**

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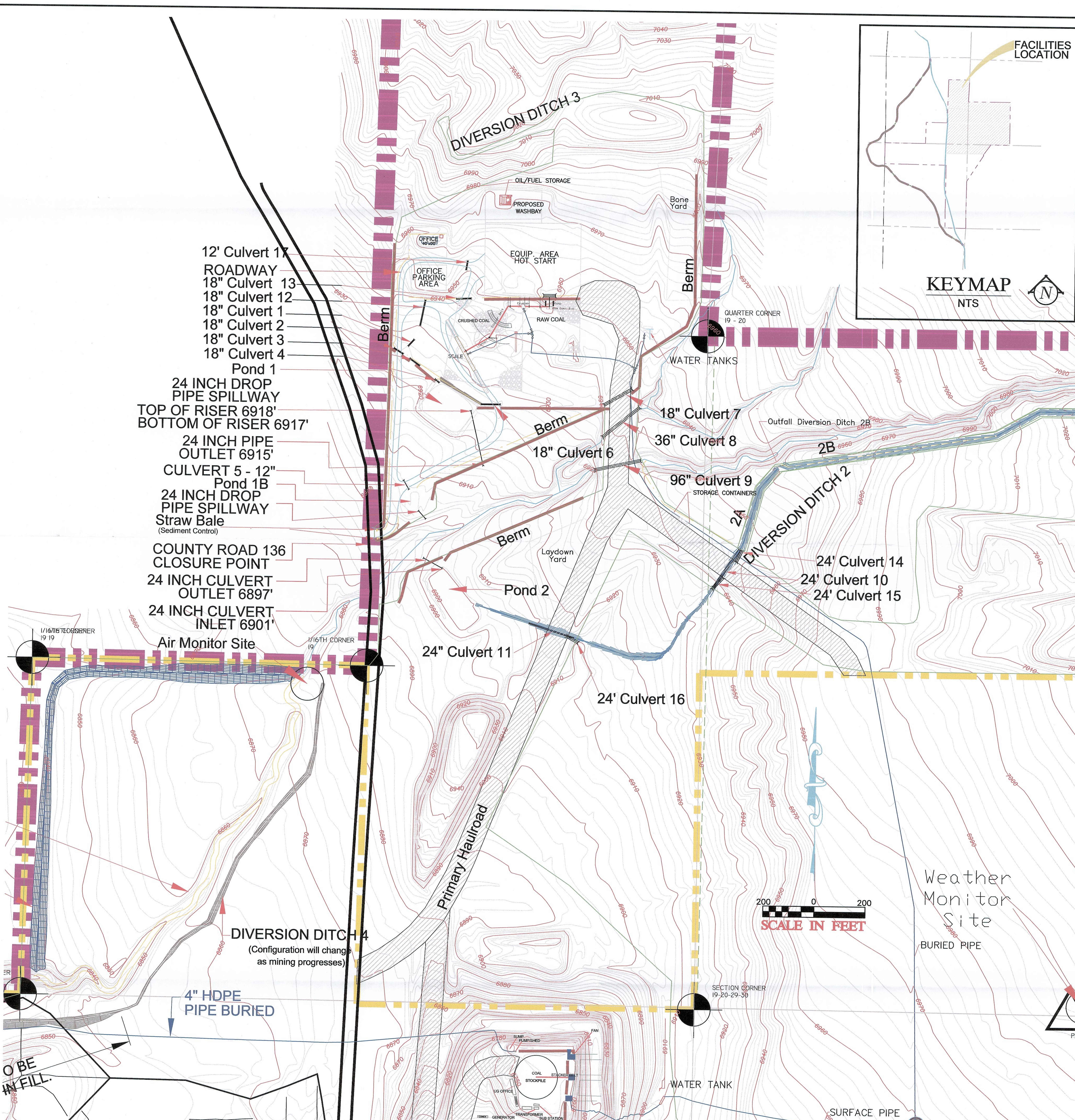
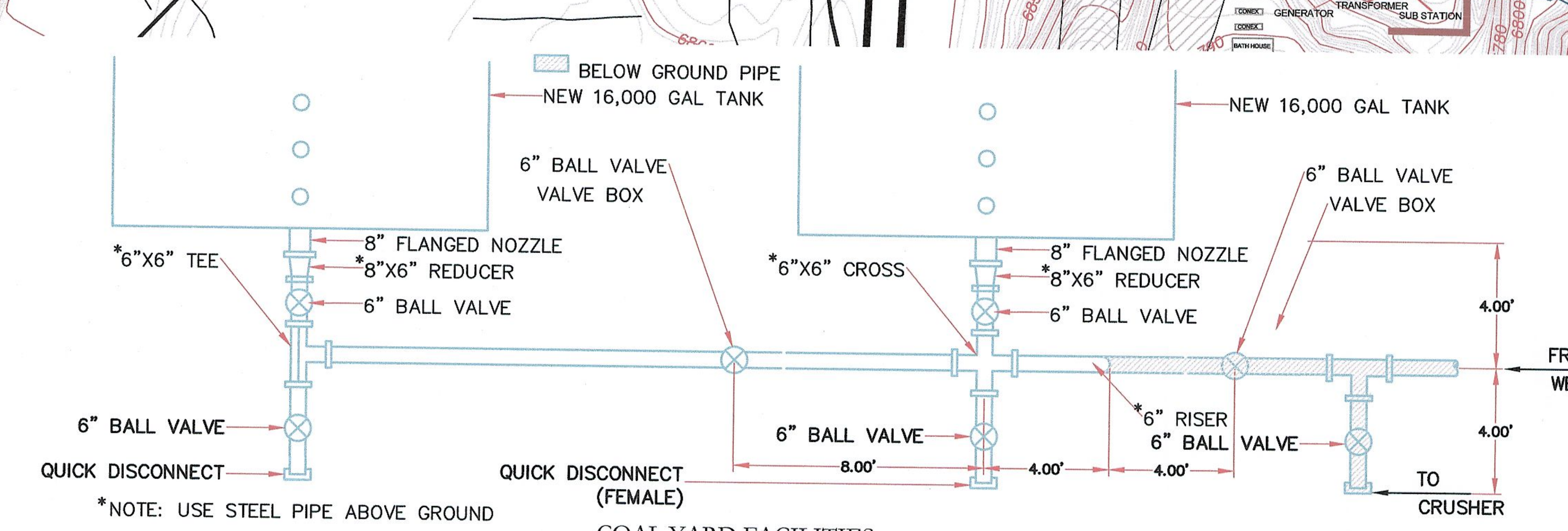
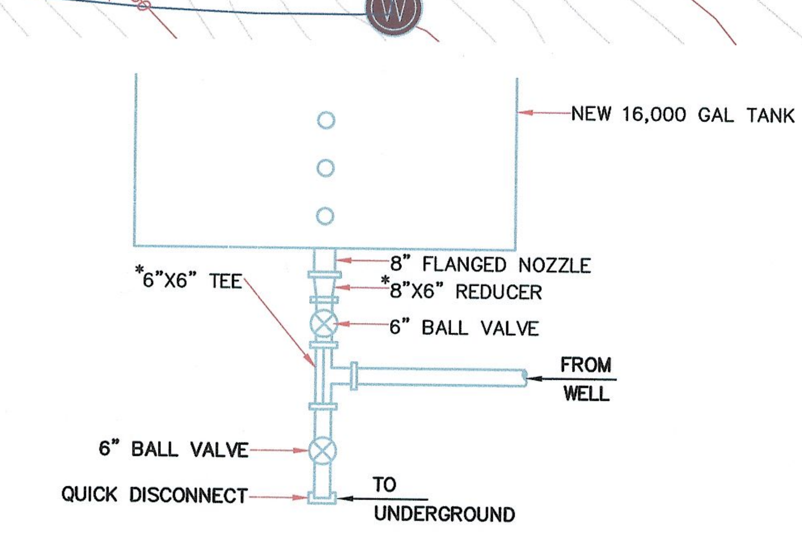
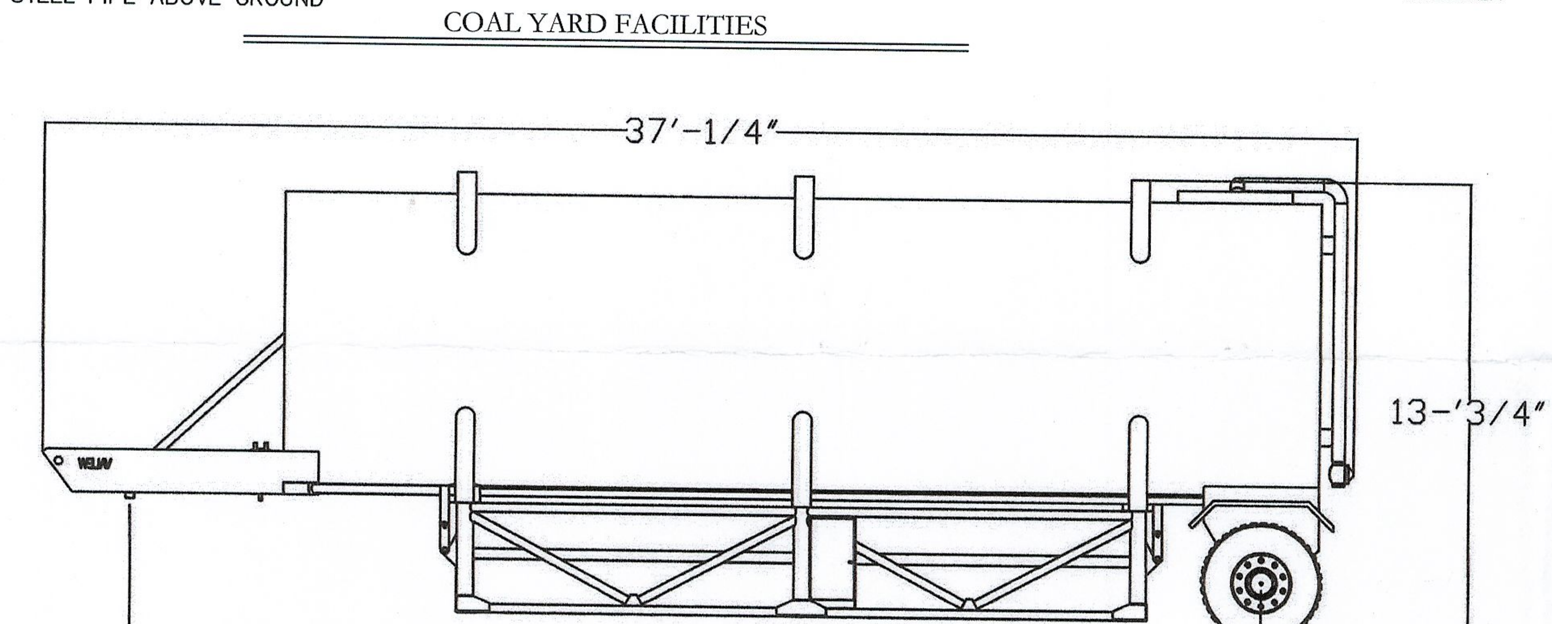



COAL YARD FACILITIES




PIT 10 UG TANK

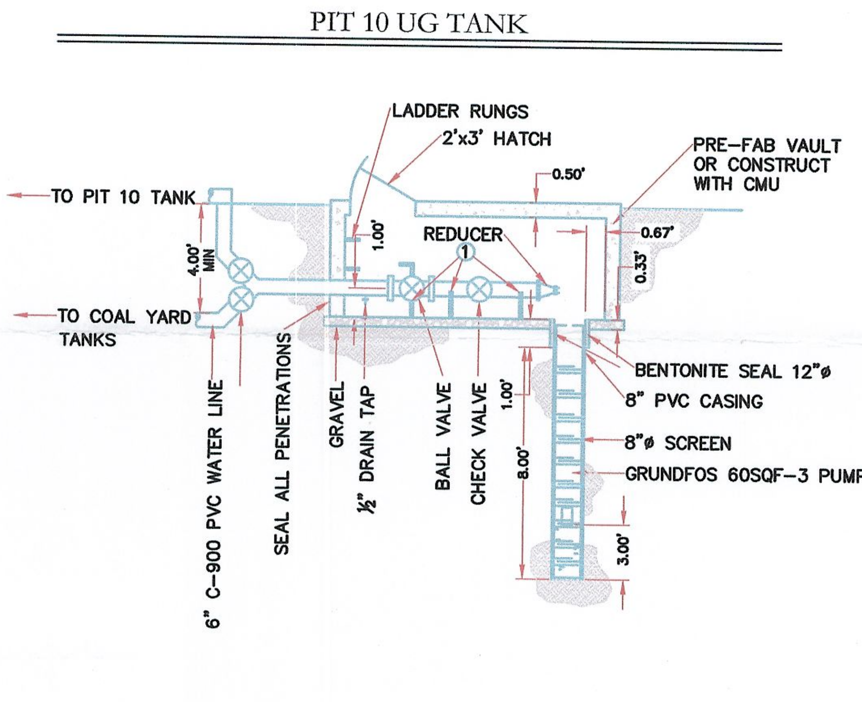



16,000 GALLON STEEL TANK DETAIL

NOT TO SCALE

SPECIFICATIONS

1. GRUNDFOS 60SQF-3 SUBMERSIBLE PUMP 50 GPM
2. 10-2 W/GRN. SUBMERSIBLE PUMP CABLE
3. CABLE CLIPS
4. STRAINING WIRE
5. WIRE CLAMP
6. TRACKING MOUNT: UTRF-168HD TRACKER (12 MODULES)
10. DIESEL- OR PETROL-DRIVEN PORTABLE GENERATOR
13. I/O GENERATOR CONTROLLER




GROUND WATER PUMP DETAIL

LEGEND:

- PROJECT AREA
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- 6" PVC C-900 WATER LINE
- EXIST. CONTOURS
- 2014-15 DISTURBANCE EXTENTS
- GROUNDWATER PUMP SYSTEM (SEE DETAIL ABOVE). 5 GPM WITH 60 FT OF HEAD.
- 12.5'(DIA) X 17.5'(L) 16,000 GAL WATER TANK MOUNTED ON SKIDS X 2 (SEE DETAIL ABOVE).
- WATER LINE VALVE

| DRAWN BY: G. GROSSMAN | CHECKED BY: CRM/WES |
|---|---|
| DRAWING: 5-8C | DATE: 11/10/08 |
| | SCALE: 1" = 200' |
| JOB NUMBER: 1400 | SHEET |

REVISIONS

| DATE: | BY: |
|---|---|
| 5/8/2015 | ARC |
| 9/28/2015 | KN |

# FACILITIES & STRUCTURES

## WATER PLAN

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-8C

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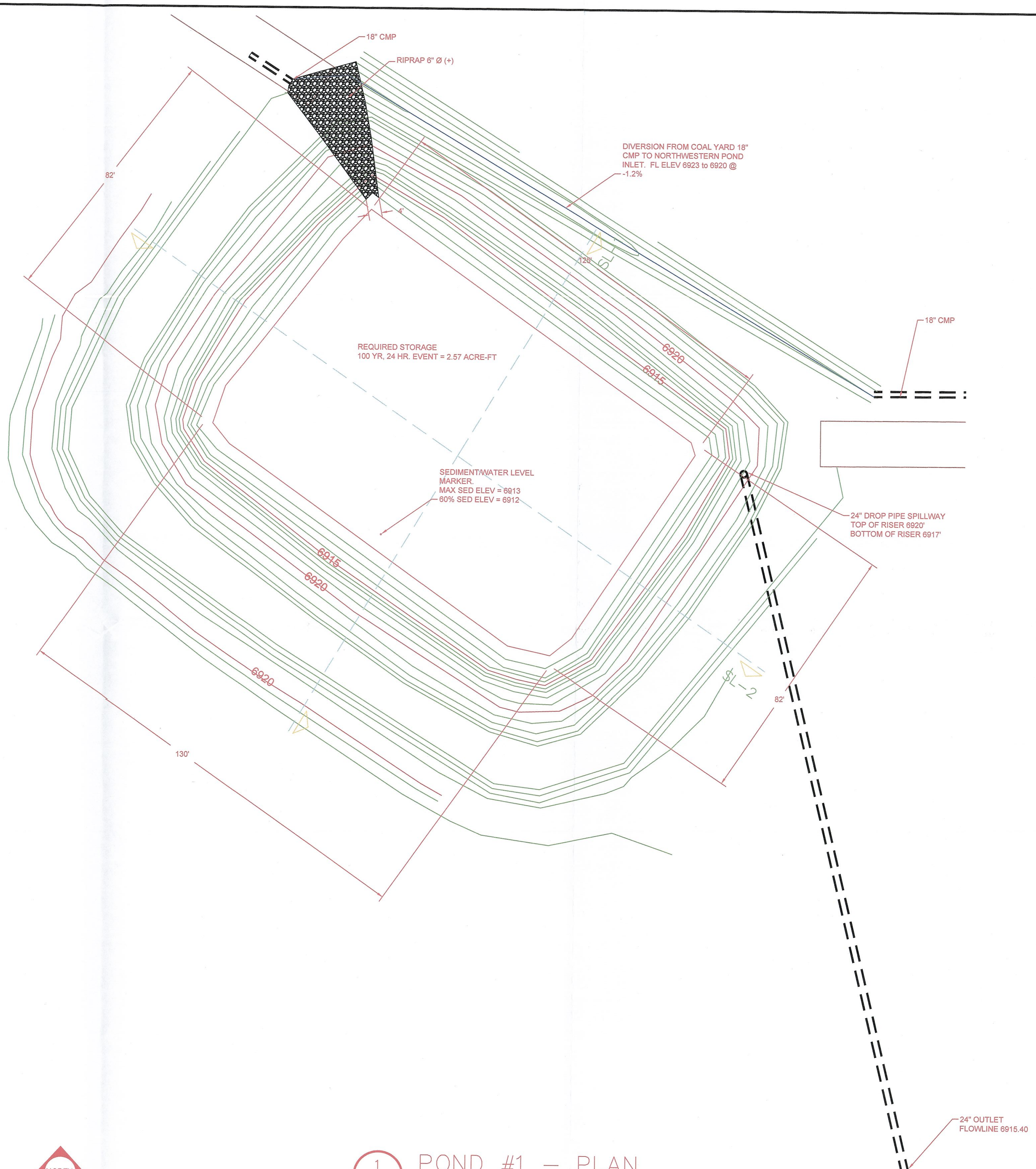
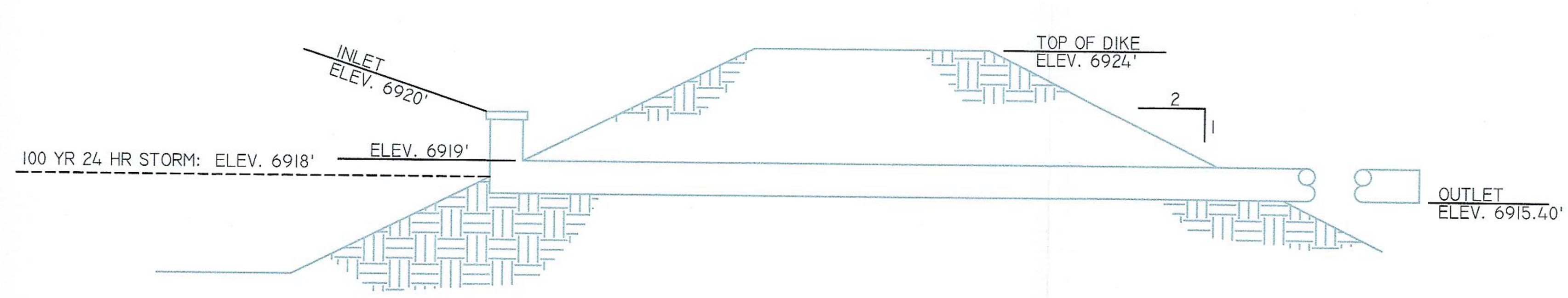



# POND #1 – PLAN

1 / C9.0

SCALE: 1" = 20'

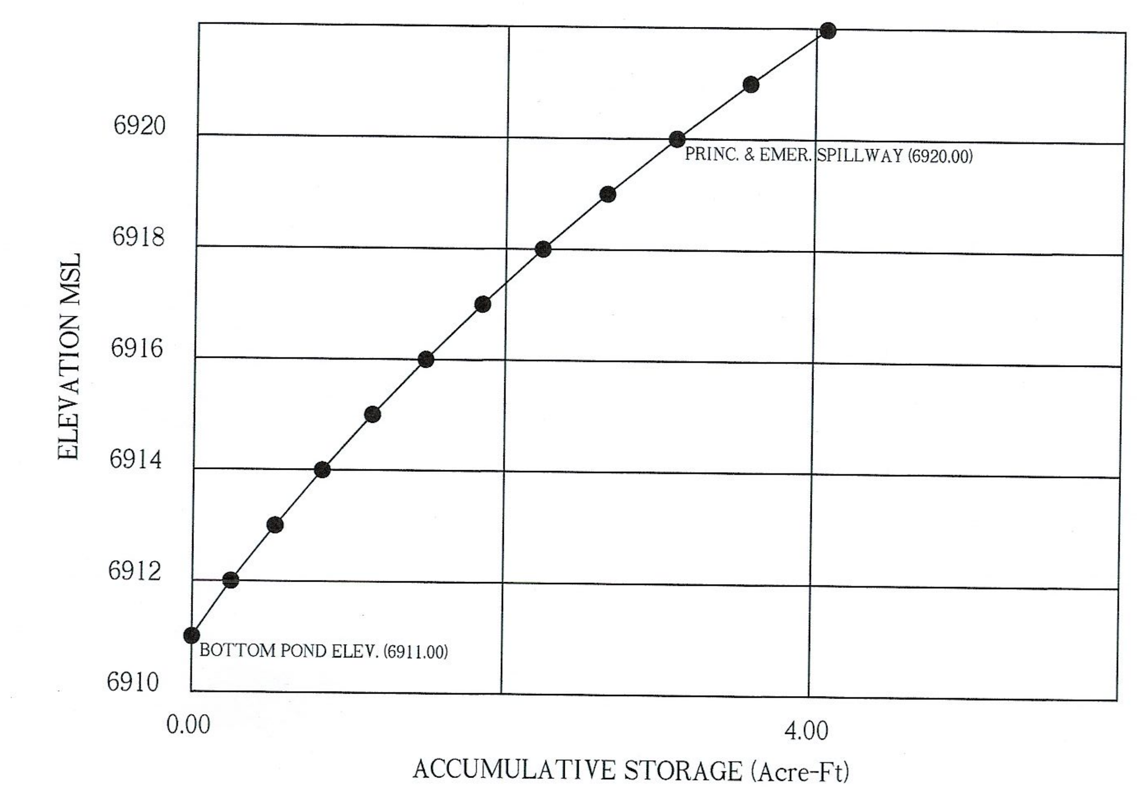



TYPICAL CROSS SECTION

Not to Scale

## STAGE STORAGE CURVE

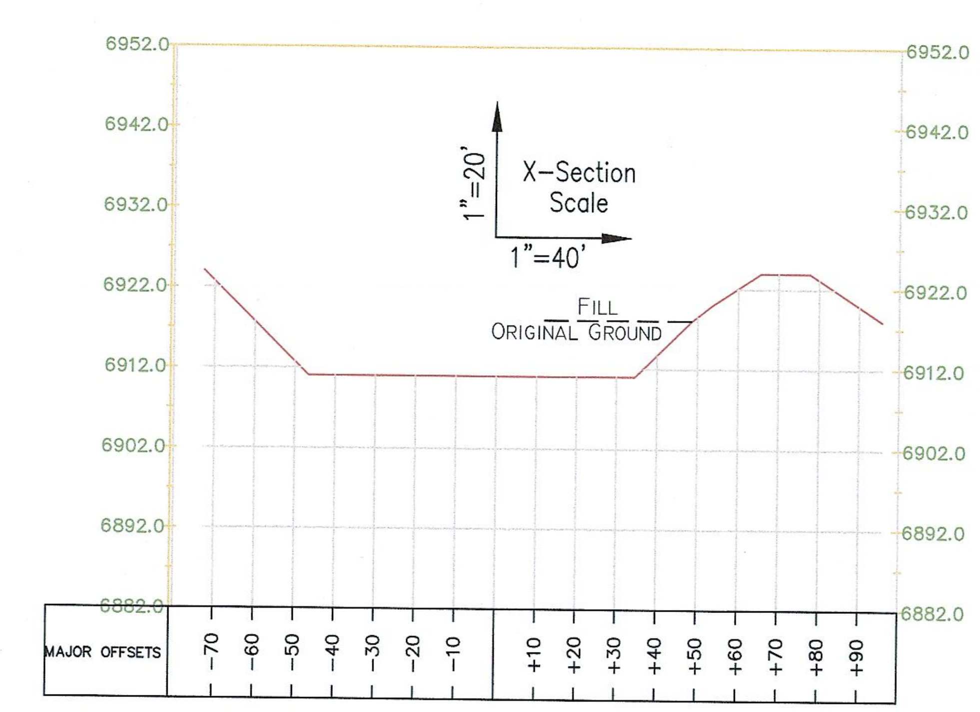
Sediment Control Structure No. 1



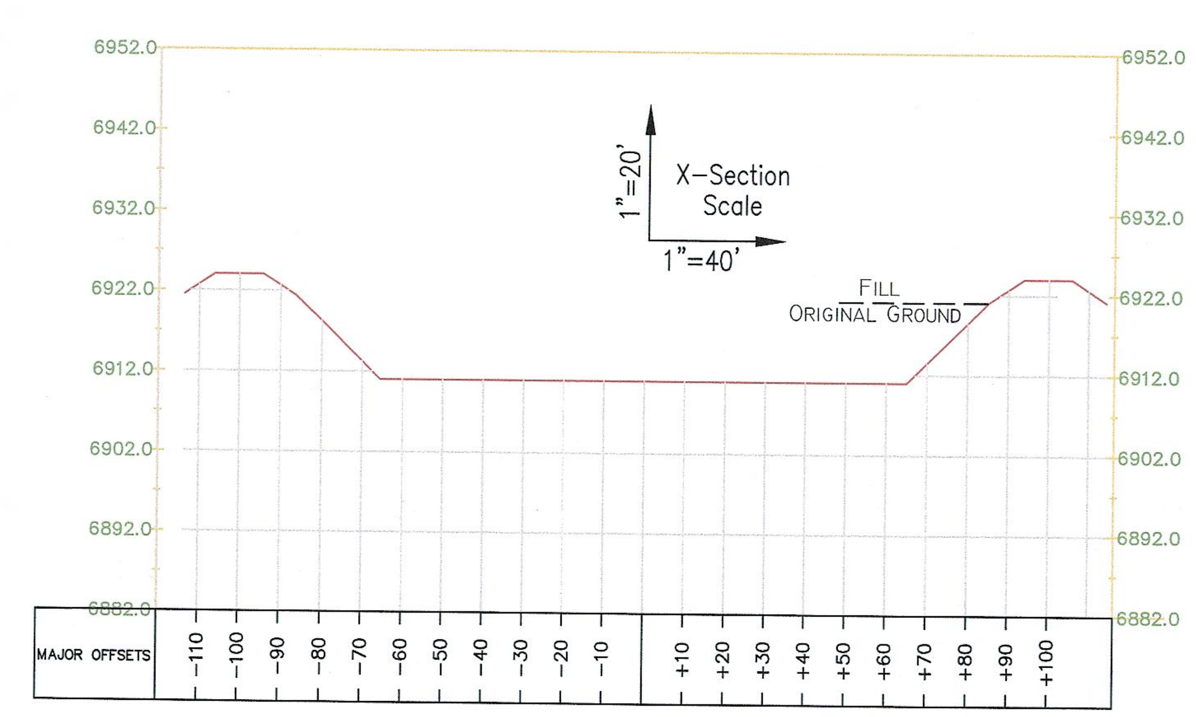

STORAGE VOLUME COMPUTATIONS

Sediment Control Structure No. 1

| ELEV. (ft) | WIDTH (ft) | LENGTH (ft) | AREA (ac) | AVG. AREA (ac) | INTERVAL (ft) | STORAGE (ac-ft) | ACC. STORAGE (ac-ft) | STAGE INTERVAL (ft) |
|---|---|---|---|---|---|---|---|---|
| 6911.00 | NA | NA | 0.2463 | | | | | |
| 6912.00 | NA | NA | 0.2849 | 0.2656 | 1.00 | 0.2656 | 0.2656 | 1.00 |
| 6913.00 | NA | NA | 0.3078 | 0.2963 | 1.00 | 0.2963 | 0.5619 | 2.00 |
| 6914.00 | NA | NA | 0.3299 | 0.3188 | 1.00 | 0.3188 | 0.8808 | 3.00 |
| 6915.00 | NA | NA | 0.3465 | 0.3382 | 1.00 | 0.3382 | 1.2190 | 4.00 |
| 6916.00 | NA | NA | 0.3609 | 0.3537 | 1.00 | 0.3537 | 1.5727 | 5.00 |
| 6917.00 | NA | NA | 0.3724 | 0.3666 | 1.00 | 0.3666 | 1.9393 | 6.00 |
| 6918.00 | NA | NA | 0.3901 | 0.3813 | 1.00 | 0.3813 | 2.3206 | 7.00 |
| 6919.00 | NA | NA | 0.4183 | 0.4042 | 1.00 | 0.4042 | 2.7248 | 8.00 |
| 6920.00 | NA | NA | 0.4476 | 0.4329 | 1.00 | 0.4329 | 3.1577 | 9.00 |
| 6921.00 | NA | NA | 0.6630 | 0.5553 | 1.00 | 0.5553 | 3.7130 | 10.00 |
| 6922.00 | NA | NA | 0.5091 | 0.5860 | 0.98 | 0.5860 | 4.2990 | 11.00 |
| 6924.00 | | | | | | | | |




SL-1




SL-2

| DRAWN BY: | CHECKED BY: |
|---|---|
| KRB | JL |
| DRAWING: | DATE: |
| 5-28 | 11/08/2010 |
| | SCALE: |
| | AS NOTED |
| JOB NUMBER: | |
| 594-01-01 | |

REVISIONS

| DATE: | BY: |
|---|---|
| 4/19/2011 | KRB |
| 5/7/2015 | ARC |
| 8/2/2015 | KN |

# SEDIMENT IMPOUNDMENT POND 1 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-28

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STATE REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

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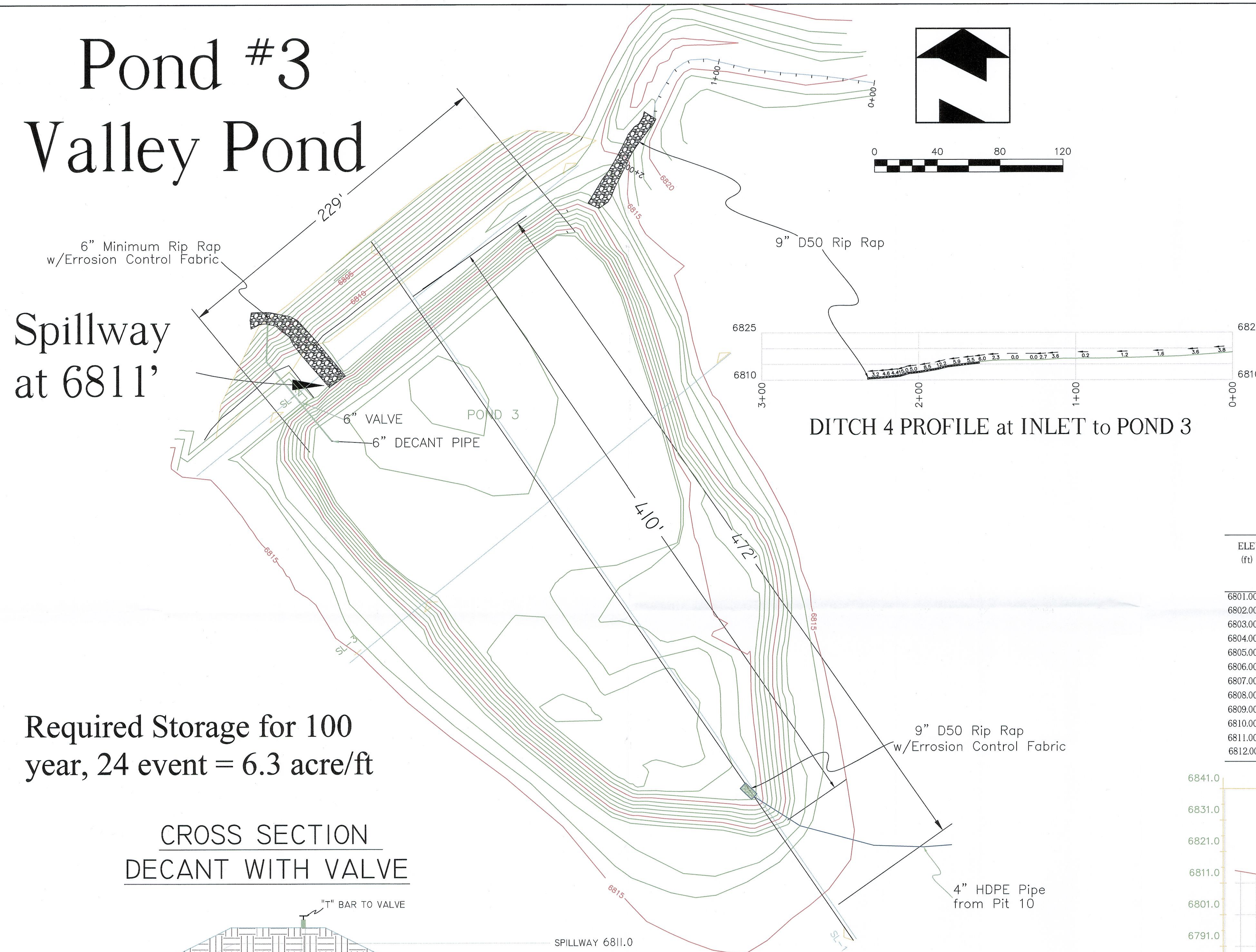
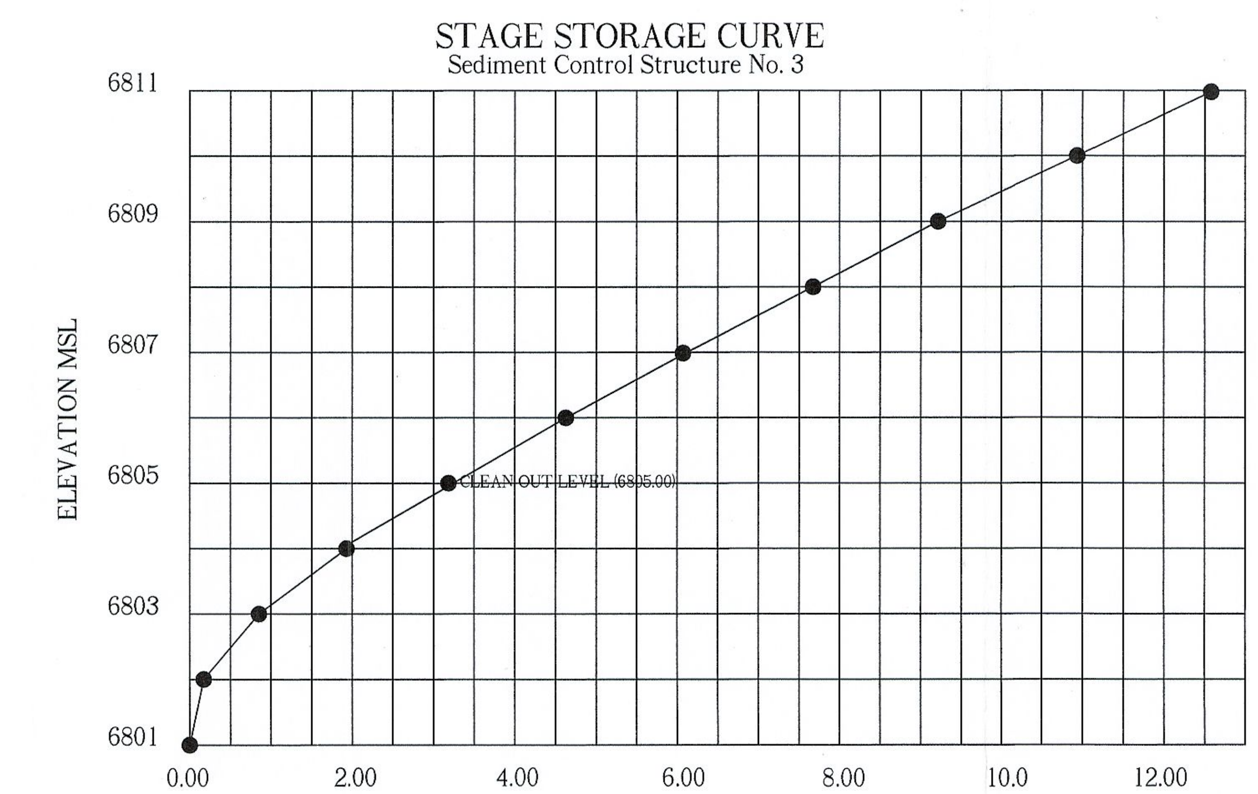
# Pond #3
# Valley Pond




DITCH 4 PROFILE at INLET to POND 3

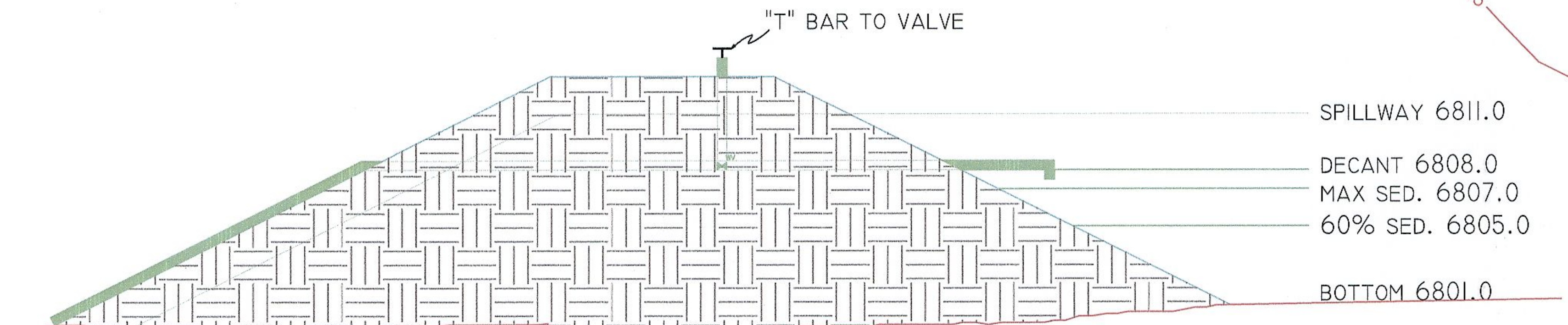



ACCUMULATIVE STORAGE (Acre-Ft)
STORAGE VOLUME COMPUTATIONS
Sediment Control Structure No. 3

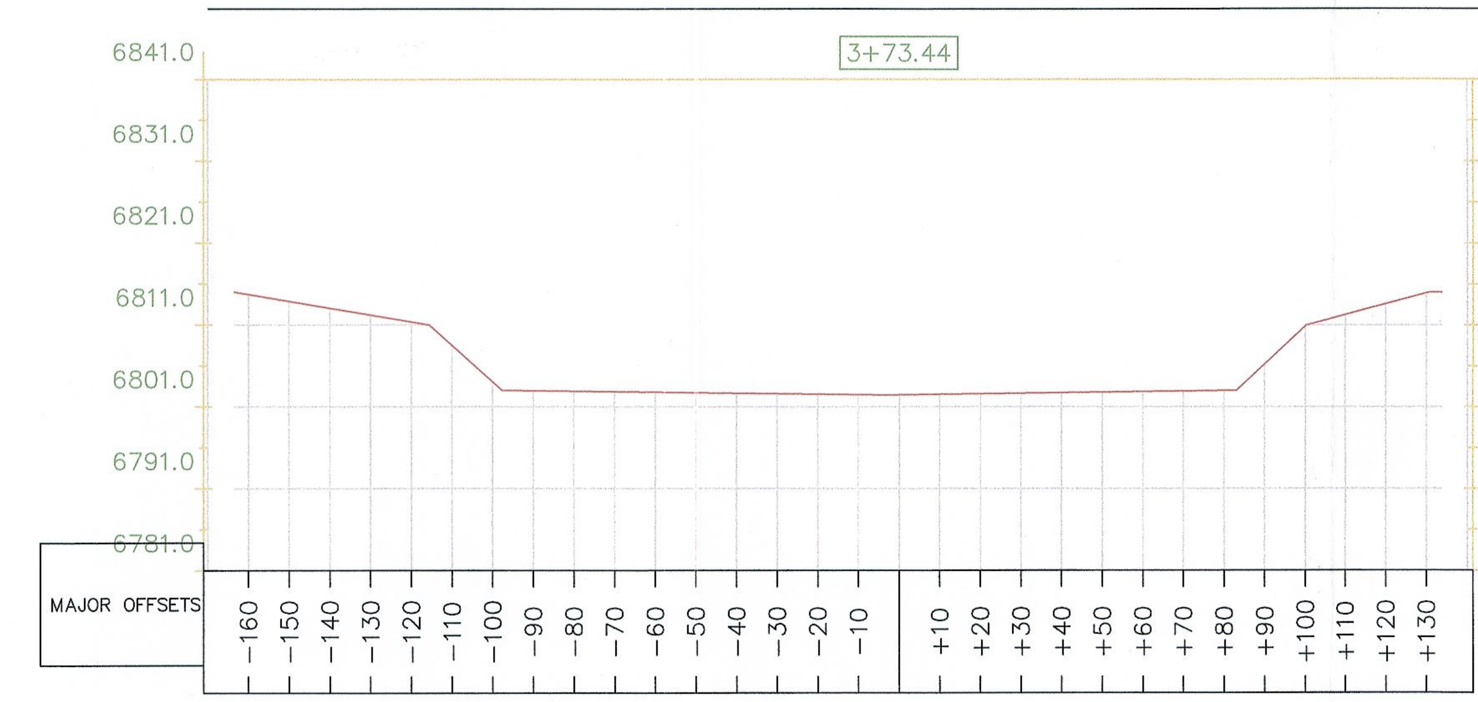
| ELEV. (ft) | WIDTH (ft) | LENGTH (ft) | AREA (ac) | AVG. AREA (ac) | INTERVAL (ft) | STORAGE (ac-ft) | ACC. STORAGE (ac-ft) | STAGE INTERVAL (ft) |
|---|---|---|---|---|---|---|---|---|
| 6801.00 | NA | NA | 0.0000 | 0.1171 | 1.00 | 0.1171 | 0.1171 | 1.00 |
| 6802.00 | NA | NA | 0.2342 | 0.6536 | 1.00 | 0.6536 | 0.7707 | 2.00 |
| 6803.00 | NA | NA | 1.0730 | 1.1462 | 1.00 | 1.1462 | 1.9169 | 3.00 |
| 6804.00 | NA | NA | 1.2194 | 1.2847 | 1.00 | 1.2847 | 3.2016 | 4.00 |
| 6805.00 | NA | NA | 1.3500 | 1.3980 | 1.00 | 1.3980 | 4.5997 | 5.00 |
| 6806.00 | NA | NA | 1.4461 | 1.4800 | 1.00 | 1.4800 | 6.0796 | 6.00 |
| 6807.00 | NA | NA | 1.5139 | 1.5434 | 1.00 | 1.5434 | 7.6231 | 7.00 |
| 6808.00 | NA | NA | 1.5730 | 1.6020 | 1.00 | 1.6020 | 9.2250 | 8.00 |
| 6809.00 | NA | NA | 1.6309 | 1.6601 | 1.00 | 1.6601 | 10.8851 | 9.00 |
| 6810.00 | NA | NA | 1.6893 | 1.7188 | 1.00 | 1.7188 | 12.6040 | 10.00 |
| 6811.00 | NA | | 1.7484 | 1.7896 | 1.00 | 1.7896 | 14.3935 | 11.00 |
| 6812.00 | NA | NA | 1.8307 | | | | | |

Required Storage for 100 year, 24 event = 6.3 acre/ft

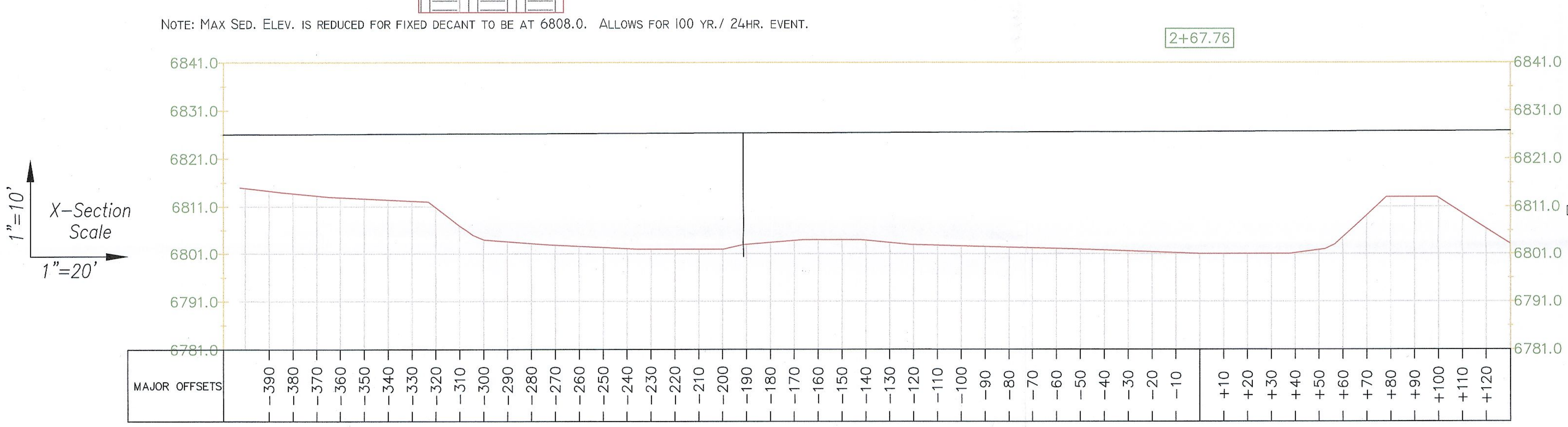
## CROSS SECTION
## DECANT WITH VALVE



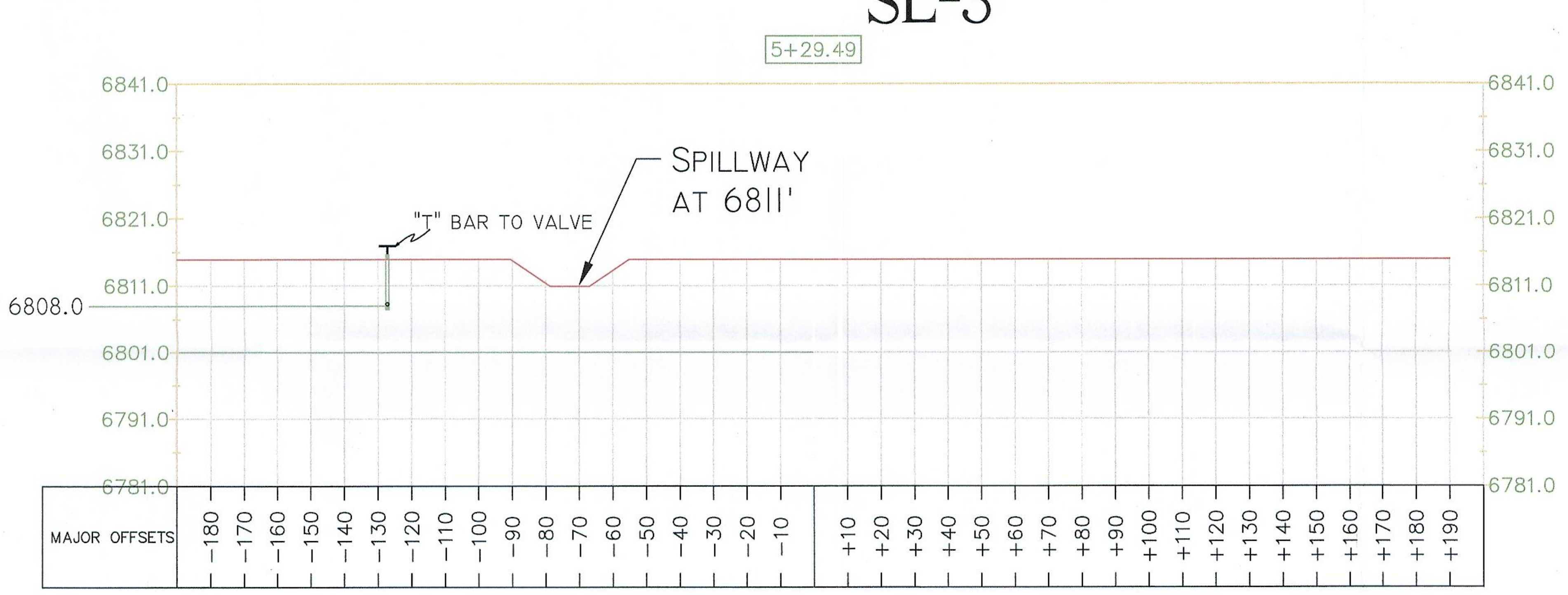

NOTE: MAX SED. ELEV. IS REDUCED FOR FIXED DECANT TO BE AT 6808.0. ALLOWS FOR 100 YR./ 24HR. EVENT.




SL-3




SL-1




SL-2

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Fax (435)867-1192

State of Utah Registered Professional Engineer #154168 Dan W. Guy 11/17/15

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SEDIMENT IMPOUNDMENT 3 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-30

| REVISIONS | |
|---|---|
| DATE: | BY: |
| 12-04-08 | CRM |
| 01-18-15 | KN |
| 91-26-15 | KN |

| | |
|---|---|
| DRAWN BY: C. MCCOURT | CHECKED BY: GG |
| DRAWING: 5-30 | DATE: 12/18/06 |
| | SCALE: 1" = 40' |
| JOB NUMBER: 1400 | SHEET |