Alton Coal Development, LLC
463 North 100 West, Suite 1
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Phone (435) 867-5311 Fax (435) 867-1192

June 24, 2016

Daron R. Haddock
Coal Program Manager
Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, UT 84114-5801

Re: **Submittal for the North Private Lease, Alton Coal Development, LLC, Coal Hollow Mine, Kane County, Utah, C/025/0005, Task ID#4942**

Dear Mr. Haddock:

Alton Coal Development, LLC (ACD) is submitting an amendment to expand the Coal Hollow Mine in Kane County to include the private properties known as the North Private Lease (NPL).

Responses to deficiencies are attached to this cover letter. Responses for all three areas from previous submissions that are unchanged remain for reference. As identified by your staff, the deficiencies pertaining to Area 2 and 3 of the NPL are highlighted in yellow. With the availability of new studies and information all remaining deficiencies have now been addressed.

Changes to the MRP associated with this amendment have been uploaded to the DOGM's server for review. PDF versions of the drawings are not certified. Upon approval, 2 (two) clean hard copies of the text and certified drawings for insertion into the MRP will be submitted. Please do not hesitate to contact me if you have any questions 435-691-1551.

Very truly yours,

B. Kirk Nicholes

B. Kirk Nicholes
Environmental Specialist
Alton Coal Development

BKN/mkm

23333953.1

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: **Alton Coal Development, LLC**
Mine: **Coal Hollow Mine** **Permit Number:** **C/025/0005**
Title: **North Private Lease Areas 2 and 3**

Description, Include reason for application and timing required to implement:

Instructions: If you answer yes to any of the first eight questions, this application may require Public Notice publication.

☒ Yes ☐ No 1. Change in the size of the Permit Area? Acres: 295.60 Disturbed Area: 224.80 ☒ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO#
☒ Yes ☐ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☒ Yes ☐ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☒ Yes ☐ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV #
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain:
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☒ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☒ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?
☒ Yes ☐ No 24. Does the application include confidential information and is it clearly marked and separated in the plan?

Please attach three (3) review copies of the application. If the mine is on or adjacent to Forest Service land please submit four (4) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

B. Kirk Nicholes	Environmental Specialist	06/24/2016	B. Kirk Nicholes
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 24th day of June, 2016

Notary Public: W. Young, state of Utah.

My commission Expires: 04/02/2018 }
Commission Number: 671357 } ss:
Address: 444 S. Main #B2 }
City: Cedar City State: UT Zip: 84720 }

WINSTON YOUNG
NOTARY PUBLIC
STATE OF UTAH
COMMISSION #671357
My Commission Expires April 2, 2018

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

Form DOGM- C1 (Revised December 10, 2007)

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: North Private Lease Areas 2 and 3

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
☐	☐	☐	
☐	☐	☐	
☐	☒	☐	(03) Chapter 5 TOC
☒	☐	☐	(04) Chapter 5, Appendix 5-15
☐	☒	☐	(05) Chapter 7 TOC
☐	☒	☐	(06) Chapter 7 Text
☒	☐	☐	(07) Chapter 7, Appendix 7-18
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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

1. The amendment does not meet the State of Utah R645 requirements of Clear and Concise. The culverts referenced in Appendix 5-12 and Appendix 5-13 do not match up.

The appendix containing the design drawings for culvert C-2 from Brown Consulting Engineers has been renamed Appendix 5-14. References throughout the text have been amended accordingly and all references to culverts now follow the same scheme.

2/3. R645-301-121.200: The amendment does not meet the State of Utah R645 requirements of Clear and Concise. The amendment has provided well logs for a number of wells, but they do not match the wells stated within the application, including: A-6, PDH-6, PDH-7. R645-301-121.200 The amendment includes poorly organized drill logs/data sheets and duplicate drill logs. The amendment must organize the drill logs and provide only one copy of each.

Duplicate drill logs and well completion information were removed from the application and the organization was corrected. Well information for wells A-6 (Y-103), PDH-6 (Y-69), and PDH-7 (Y-70) remains in the application. Information on wells with more than one name ID is provided in Appendix 7-16 Table 3, and the index for sub-Appendix B. Additional clarification of alternate well name ID's has been added to Sub-Appendix B of Appendix 7-16 for clarity.

4. R645-301-820.113, R645-301-112.800 and R645-301-142, With this application, the Permittee has chosen to bond for surface disturbance in Area 1 and for overburden and coal removal in Pit 1 only (incremental bonding within Area 1). The Pit 1 bond polygon is shown on Drawing 5-77 North Area Bond Polygons. The extent of Pit 1 in relation to the rest of Area 1 can be seen by viewing Drawing 5-57 North Area Overburden Removal Sequence. For the purpose of incremental bonding, Bond Exhibit A must show both Area 1 and Pit 1 and the legal description of both Area 1 and Pit 1 must be provided.

The bond general purpose rider has been amended to add drawing B-2 for the North Private Lease, specifically showing Permit Area 1 and Pit 1 boundaries. The legal descriptions for both perimeters have been included.

5. R645-301-130: The amendment does not meet the State of Utah R645 requirements for Reporting of Technical Data. The amendment must report all well completion information for all existing and future wells within and adjacent to the North Private Lease and the production well in the south lease. This information must include:
1. Location, date drilled, and aquifer represented.
2. Ground elevation and elevation of the measuring point.
3. Drill bit and casing diameter.
4. Packer base depth and elevation.
5. Casing depth and total depth.
6. Total hydraulic head elevation.
7. Method of measuring formation pressure.
8. Gravel pack - yes or no.
9. Casing material.
10. Well development techniques.

Well completion information was provided previously in Appendix 7-16 (Tables 1 and 3 and Sub-Appendix B). Packers are not present in any of the Coal Hollow Mine area wells nor are there any *permanent/dedicated pressure measuring devices. Information on well development methods at well Y-103 has been added to the application and is provided in Sub-Appendix C of Appendix 7-16.*

6. R645-301-121.200: The Permittee did not correct the Table of Contents updating all appropriate appendices to include those created within incorporated amendments. Specifically, there are two Appendix 5-13 with different names. All references of said appendices throughout the MRP must also be updated, e.g. Chapter 5 Section 511.100-511.300 pg. 5-1

The appendix containing the design drawings for culvert C-2 from Brown Consulting Engineers has been renamed Appendix 5-14. References throughout the text have been amended accordingly and all references to culverts now follow the same scheme. The TOC for chapter 5 has been updated accordingly

7. The information in the application in the application is not adequate to meet this section of the regulations. Prior to approval the following information is required in accordance with R 645-301-121.300; The information submitted in the latest response dated 12/18/2015 has not been presented in a format approved by the Division and does not correspond to the deficiencies noted in the R645 coal rules. The applicant needs to address the deficiencies as they are formatted and referenced in accordance with the R645 coal rules.

Discussions with Daron Haddock on 1/8/2016 and on 1/13/2016 indicate that the reviewer misunderstood the format of the 12/18/2015 submittal that ACD should disregard this deficiency.

8. Maps clearly showing areas inventoried to identify extent of cultural resources down-gradient from the ASCA and ponds in Area 1 must be included in the additional cultural resource inventory report. Maps must include all information as described under R645-301-200-140-142.

Past inventories provide the necessary information to show the locations of cultural resources adjacent to the North Private Lease. Exhibit 4-7 has been added to Appendix 4-7 (Volume 9, confidential) depicting Eligible cultural sites in relation to work areas, Area 1, ASCA-1 & ponds within North Private Lease. Additionally, text has been updated in Chapter 4 Page 4-12 describing the relationship of cultural resources down-gradient of ASCA and Ponds in the NPL.

9. Maps clearly showing the proposed locations of the ASCA and ponds in Area 1 in relation to cultural resources must be included in the additional inventory report. Maps must include all information as described under R645-301-200-140-142.

See response to deficiency #8

10. R645-301-411.141.1: The Permittee must provide maps for the North Private Lease area that "clearly show" the "boundaries … and locations of any cultural and historical resources listed or eligible for listing in the National Register of Historic Places and known archaeological sites within the permit and adjacent areas." These are confidential in nature, but should be included in the appropriate Appendix. This includes, but is not limited to, a map showing the area inventoried during efforts to identify cultural resources within the North Private Lease area, a map showing identified sites in relation to the proposed lease area boundaries, etc.

See response to deficiency #8

11. The information in the North Lease application is not adequate to meet the requirements of this section of the regulations. Prior to approval the following information is required in accordance with R 645-301-322; ACD will need to provide a commitment to update Wildlife map # 4 and the text on page 33 of volume 12 as part of the North Lease application by February 1st, 2016 for areas 1, 2 and 3.

Discussion with Ben Nadolski requesting the new data has been initiated to obtain the new information. DRW is working to provide it at which time it will be provided as an update to this submission of the application.

12. ACD will need to provide a commitment to conduct a Northern Leopard Frog survey in areas 2 and 3 prior to conducting mining and or mine related activities in those areas.

This frog is not a federally protected species and it is fairly common in Utah. ACD will conduct a survey for Northern Leopard Frog in 2016 prior to mining in Areas 2 and 3.

13. R645-301-725: The amendment does not meet the State of Utah R645 requirements for Baseline Information. The application does not meet the minimum hydrologic and geologic baseline cumulative impact area requirements for the alluvial aquifer within the permit area. Additional information is needed regarding the vertical and horizontal alluvial aquifer characteristics.

I. Aquifer Hydraulic Characteristics

Hydrogeologic characterization of the permit area requires a detailed narrative, maps, and supporting calculations of the mining method, extent of disturbance, depth of the pit, duration of the mining, and potential impacts to surrounding water resources and water rights. The amendment must: 1) determine the hydraulic characteristics of the alluvial aquifer that will be affected by mining; 2) estimate the areal extent of static water level declines in the affected aquifer; 3) evaluate potential impacts to water resources due to mining, and 4) estimate groundwater conditions and aquifer characteristics likely to exist after reclamation.

a. Hydrogeologic Characteristics

The amendment must include a narrative summary of hydrogeologic characteristics including the following:

(1) Number of aquifers and their intercommunication;
(2) Aquifer characteristics and variability;
(3) Direction of flow and significance of recharge and discharge areas to the sites;
(4) Significance of hydrologic boundary conditions;
(5) Potentiometric surface(s);
(6) Water quality; and
(8) Adjacent and regional potentiometric surface(s)

b. Aquifer Tests

Aquifer tests must be used to determine transmissivities, hydraulic conductivities, storage coefficients, hydrologic boundaries, leakage, aquifer homogeneity, and isotropy. For example, a multi-well pump test evaluation, as described by Theis (1935), Cooper and Jacob (1946), Boulton (1954), or a test as summarized by Lohman (1979). A data log for each aquifer test must be included in the application to identify both a chronological order of events and decisions that were made during testing. The location and number of aquifer tests should be sufficient to characterize the different hydrogeologic environments present within the potentially affected area. At a minimum, at least one aquifer test should be performed for each potentially affected hydrogeologic environment identified during the preliminary geologic investigation.

Within the data log mentioned in the above paragraph, the following information must be submitted for each aquifer or pumping test:
(1) All data obtained from the aquifer tests and measurements necessary to evaluate the testing results; and
(2) Methods of analyses:
(a) List the methods of analyses and equations used;
(b) List the assumptions upon which the equations are based;
(c) List how assumptions were met by the physical conditions; and
(d) Present sample calculation.
(3) Graphs which show:
(a) All drawdown and/or recovery data;
(b) Curve or line fits;
(c) Match points, u, W(u);
(d) Boundary and casing storage effects;
(e) Pump breakdown;
(f) Discharge adjustments; and
(g) to.
(4) Correction factors and their associated supportive data and the method used for data adjustment
(5) Results of analyses:
(a) Hydraulic conductivity;
(b) Transmissivity; and
(c) Storage coefficient or (apparent) specific yield.
II. Potentiometric Surface
a. Affected Alluvial Aquifer
Potentiometric surfaces should be extended into all units which are in good hydraulic communication with the aquifer. The potentiometric surface map must also show well locations, groundwater recharge and discharge areas, and other hydrogeologic features.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

14. R645-301-725; R645-301-731.710; R645-301-728: In order to better determine the probable hydrologic consequences of the operation upon the quality and quantity of surface and ground water in the permit and adjacent areas a Gain/Loss study will need to be done on Kanab Creek as it passes through the permit area. This study must include a map identifying gaining and losing sections of Kanab Creek during base flow conditions. All wells and surface water monitoring points used to support conclusions must be shown on the map.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

15. R645-301-725, R645-301-728: The total volume of surface and groundwater outflow from the permit area will be calculated at the location of the monitoring well matrix just south of the permit area (See Groundwater Monitoring Plan for a complete description on the well matrix). The surface flow will be combined with the volume of groundwater discharged through the monitoring well matrix (cross-sectional area of alluvial aquifer perpendicular to flow, hydraulic conductivity, hydraulic gradient,

transmissivity, etc.) to determine the total volume water outflow from the permit area. The methodology, calculations, a geologic cross-section(s), and stream cross-section must be given to support how each parameter variable is determined and ultimately used to determine the final outflow variable.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

16. R645-301-725: The amendment must provide a statistical analysis to support the conclusion that it is common for Kanab Creek to have, "no discharge south of the tract during much of the year". If no statistical analysis with supporting graphs are provided the statement must be removed.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

17. R645-301-726; R645-301-731.800:
I. Open-Pit Drawdown Modeling
1) The drawdown model must be used to predict mine related impacts to the hydrologic system. The modeling results must be used to assess probable hydrologic consequences and cumulative hydrologic impacts.
2) A detailed and complete description of the model must be submitted and include:
(a) The approach to the problem and the chosen model (ex. finite difference);
(b) A written description of all equations;
(c) A list of simplifying assumptions, sinks, sources and boundary conditions;
(d) The solution techniques for the equations (e.g., strongly implicit procedure (SIP), line successive over-relaxation (LSOR) and alternating direction implicit procedure (ADI));
(e) The grid nodes superimposed on a base map of the same scale as the premining potentiometric map;
(f) The selection of time steps;
(g) A table of the input data; and
(h) A sensitivity analysis.
3) The maps should be updated with new data every 2 years, at a minimum, unless water level response has changed significantly over the past year, in which case a new map should be submitted.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

18. R645-301-728: The application must provide calculations and a supporting analysis of the cone of depression associated with each open-pit and highwall auger hole within the North Privae lease. This analysis must be supported with cross-sectional and plan view maps, tables, and graphs. The analysis must provide a discussion on the response of flow in Kanab if the cone of depression is expected to extend to and/or beyond the creek. This analysis must also provide a discussion on any stratigraphic units encountered in drill holes that may have a stronger influence on the aquifer's response to drawdown. A discussion must be provided on any interruption of flow along the length of Kanab Creek that may result in material damage to the water resources within and adjacent to the permit area.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

19. R645-301-728: The areal extent, magnitude, and duration of static water level declines expected in the affected aquifer should be predicted. This should include a description of the drawdown model results, the extent of the five-foot drawdown contour and measures verification of the drawdown predictions.

The final predicted postmining groundwater flow should be compared to the premining groundwater flow and discussed with respect to the potential for impacts to the local and regional groundwater system. The comparison and discussion should include a description of the anticipated post-reclamation groundwater system. The discussions and maps used in this description should be supported by data and referenced material and should include:

(1) Final aquifer hydraulic properties (e.g., hydraulic conductivity, storativity, saturated thickness, etc.) including those of backfilled overburden;

(2) Anticipated post-reclamation potentiometric surface and estimated time to resaturate; and

(3) Post-reclamation effects on adjacent aquifers, wells, springs, and surface waters.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

20. R645-301-724.310, R645-301-731: Additional groundwater monitoring wells must be installed in the alluvial aquifer within and adjacent to the North Private lease and positioned so as not to be destroyed by mining activities. The intent of these wells is to monitor any impact that active mining may have on the quantity and quality of groundwater and surface water in Kanab Creek within and adjacent to the permit area. The alluvial aquifer groundwater must be monitored at multiple vertical depths and multiple areal locations in three zones: 1) just north of the permit area, 2) on both the east and west sides of Kanab Creek in-between the creek and the active mine workings, and 3) just south of the permit area. The methodology of selecting the specific well locations and identifying the screened interval lengths and depths based on relevant well log data must be outlined. The alluvial aquifer must be measured at multiple vertical depths and the wells must be tightly grouped, such as the C- and S-well groups found in the southern permit area. The monitoring wells must be screened across gravel lenses with the highest permeability. The specific locations for these monitoring wells are:

1) A groundwater monitoring well must be installed within the alluvial aquifer directly north of the permit area on the west bank of Kanab Creek. The well will be no more than 100 yards from Kanab Creek and no more than 100 yards north of the permit area.

2) Groundwater monitoring wells must be installed on the east and west banks of Kanab Creek. These wells will be installed between active mining and the creek. There will be at a minimum three groundwater monitoring locations that will be roughly equally spaced along the length of the creek through the permit area.

3) Groundwater monitoring wells must be installed downstream of the permit area no more than 140 yds downstream of the county road where it crosses Kanab Creek. The monitoring wells will be placed in the gravel alluvium (D50 > 1 cm) at point where the quantity of surface flow in Kanab Creek is readily and accurately measured. A minimum of four wells will be installed in the bottom of the Kanab Creek channel floodplain in a 2 x 2 gridded matrix. The matrix will be positioned to have both the two well arrays running along cross-sections that are perpendicular to flow in Kanab Creek. Both two well arrays

will be spaced no more than 15 yards apart. The wells will be fully screened from the water-table to the bottom of the alluvial sediments resting on the bedrock. The two wells along the perpendicular array will be equally spaced along the cross-section in the bottom of Kanab Creek's floodplain channel.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

21. R645-301-725.100; R645-301-731.211: The prevailing potentiometric gradient must be monitored between the open-pits and Kanab Creek from pre-mining through Final Bond Release.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

22. R645-301-731.210: The post-mining monitoring network must include the undisturbed monitoring wells and a minimum of one backfill monitoring well through Final Bond Release.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

23. R645-301-411.140: The Permittee must describe efforts undertaken to identify archaeological and cultural resources down-gradient from hydrological outflow points on adjacent areas outside the permit boundaries including:
1. An additional inventory must be conducted for the purposes of identifying and assessing cultural resources in areas adjacent to and down-gradient from the ASCA location associated with Area 1 and adjacent to and down-gradient from any pond facilities in Area 1, if previously conducted inventories indicate the presence of cultural resources in the area.

See response to deficiency #8

24.
2. A supplemental report must be drafted addressing inventory and assessment measures taken to ascertain extent of cultural resources located down-gradient from the ASCA location associated with Area 1 and down-gradient from any pond facilities in Area 1, if previously conducted inventories indicate the presence of cultural resources in the area.

See response to deficiency #8

25. R645-301-411-141: The Permittee must address the following items to comply with mapping requirements identified under paragraphs 411.140 to 411-141.3:
1. Maps clearly showing areas inventoried to identify extent of cultural resources down-gradient from the ASCA and ponds in Area 1 must be included in the additional cultural resource inventory report. Maps must include all information as described under R645-301-200-140-142.

See response to deficiency #8

26.
2. Maps clearly showing the proposed locations of the ASCA and ponds in Area 1 in relation to cultural resources must be included in the additional inventory report. Maps must include all information as described under R645-301-200-140-142.

See response to deficiency #8

27. R645-301-121.100: Contact information for Agency personnel discussed in the 2010 discovery plan for archaeological resources does not reflect the current staffing. This must be updated to include the DOGM contact.

Contact information for the DOGM has been added to section 411 of Chapter 4.

28. R645-301-200-140 to 142: The Permittee must address the following items to comply with mapping requirements identified under paragraphs 200-140 to 200-142:
1. Maps clearly showing areas inventoried to identify extent of cultural resources down-gradient from the ASCA and ponds in Area 1 must be included in the additional cultural resource inventory report. Maps must include all information as described under R645-301-200-140-142.

See response to deficiency #8

29.
2. Maps clearly showing the proposed locations of the ASCA and ponds in Area 1 in relation to cultural resources must be included in the additional inventory report. Maps must include all information as described under R645-301-200-140-142.

See response to deficiency #8

30. The amendment does not meet the State of Utah R645 requirements for Cross Sections and Maps. The following deficiencies must be addressed prior to final approval.
R645-301-512.110; R645-301-512.140; R645-301-724.300; R645-301-728.340; R645-301-121.200: Cross-sections extending through the affected area must identify:
(1) Potentiometric surface(s) and equipotential lines;
(2) Lithologies;
(3) The coal seam;
(4) Geologic features such as faults, paleochannels, gravel deposits, etc.;
(5) Extent of mining, open-pit and highwall;
(6) Aquifers and aquitards;
(7) Areas of aquifer communication;
(8) Hydrologic boundaries;
(9) Recharge and discharge areas; and
(10) Wells used for hydrogeologic interpretations;
(11) Crop and enlarge cross-sections to be the width of permit boundary.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

31. R645-301-512.120, -528: Drawings 5-54 through 5-56 will be amended to show complete information within the Permit Area.

Drawings 5-54 to 5-56 have been modified with notes explaining that the coal seam model shows an erosional boundary on the southwest margin of the lease area, and therefore no coal. The isopach lines on the drawings in question illustrate this.

32. Area 1:
R645-301-521.140: The Permittee will amend the Permit area to match the Area 1 boundary and the rename the footprint of Area 2 and Area 3 as future application areas and be grayed out or some other call out that clearly details that the current application does not include said areas.

To satisfy the request of the division while remaining consistent with previously published materials, the boundary previously depicted on all drawings as the "Permit Boundary" has been re-labeled as the "Lease Boundary." The individual review areas have thus been relabeled as "Permit" Areas 1, 2, and 3, respectively. The notes on each of the drawings calling out Areas 2 and 3 as remaining under review thereby show that only Permit Area 1 is currently proposed for inclusion in the MRP.

33. R645-301-521: The Permittee failed to update the narrative of 521 and 523 describing the mining operations to match the updated drawings pertinent to the single mining of Pit 1 and Area 1.

Narrative has been added to sections 521, 523, 526, 528, and 553 that give a description of Permit Area 1 sequence, constraints, soils handling, bond increments, etc.

34. Area 1:
R645-301-521.140: Text was added to the MRP Chapter 5 Section 521.140 detailing the total disturbance for the North Lease is expected to reach a 92.8 acres within the first year, this information must be updated to reflect mining operations within Area 1 as well as include a discussion of the area disturbed for mining of just North Private Lease Pit 1.

The analysis supplied by the division for this deficiency shows that the disturbance sequence had been updated previously as requested. See response to deficiency #33 for items relating to discussion of Permit Area 1 and Pit 1.

35. R645-301-521.140: MRP is missing discussion how Pit 1 with Area 1 will be bonded and how the bond will be increased incremental throughout Area 1.

See response to deficiency #33

36. R645-301-411.144: The Permittee must follow the process for the development, approval, and implementation of an appropriate treatment and mitigation plan to address Adverse Effects to sites 42KA3077 and 42AK3097, and to ensure No Adverse Effects to site 42KA6088.

A draft treatment plan has been provided to DOGM. Once DOGM and SHPO has concurred and a dig permit is issued, ACD will implement the treatment plan.

37. Area 1:

R645-301-521.133 & R645-103-.224.422, R645-301-526, R645-301-542.600: The Permittee failed to provide written proof of measures to be used to ensure that the interest of the public and landowners affected are protected with the realignment of K3100. (e.g. A letter communicating the ownership of the road, maintenance, bonding, and use of K3900 and K3100 by the public needs to be provided to the Division.) There is no written finding in regards to K3100 within not requiring the same level of proof Grant of Easement, Permit and Design by Kane County DOT, no proof of public notice, and no written statement from Kane County waving the requirement of such measures. The Permittee must also provide extensive information of how the public will be informed and protected with the utilization of left hand traffic, as detailed in the Kane County Letter, for 1.6 miles on a public road. The Findings are located within the Technical Analysis.

This alleged public road deficiencies is the same as deficiency # 33 from DOGM's December 10, 2016 Task ID#4942 and ACD incorporates by reference it's previous response and the letter dated December 15, 2015 from ACD to Associate Director Dana Dean which addresses these deficiencies. Specifically, ACD's letter asks DOGM to make a finding that relocation of both K3100 and K3900 is in the public interest. Second, contrary to the allegations of the deficiency, proof of public notice of both road relocations is provided in the MRP, Appx 1-5, Affidavit of Publication. The public notice provides a legal description which includes both road segments. Third, ownership of the public road is evidenced by the Grant of Easement dated September 18, 2015, attached to Kane County's October, 2015 letter to Ms. Dean and enclosed in ACD's letter to Ms. Dean. In addition, ACD's letter refers to the portion of the Utah Code which confirms that the roads are owned by Kane County and subject to their exclusive jurisdiction.

The only new issue raised by this deficiency is left hand road traffic. This issue was addressed by Kane County in its letter to Larry Johnson dated December 15, 2015 enclosed with ACD's letter to Ms. Dean dated December 15, 2015. Kane County states in that letter, "Alton Coal will be able to operate up to the agreed 12 foot width construction type trucks with <u>typical left side operation</u>…" (emphasis added) Left side operation is the typical mode of the roadway. The County Commission and Louis Pratt, County Transportation Director confirm in the letter that Kane County has determined that public safety will be met due to : i) the additional 32 foot road width; 2) the short distance of 1.6 miles; 3) the limitation of truck length to 12 feet; 4) typical left-side operation; and 5) reduction of road speed to 25 miles per hour. This traffic safety issue is within the exclusive scope of Kane County's authority and they have approved this use of the road as set forth in December 15th letter to Mr. Johnson. DOGM does not have jurisdiction over traffic on public roads. Therefore, there is no basis for Ms. Parker's allegation that "The Permitee must provide extensive information of how the public will be informed and protected with the utilization of left hand traffic, as detailed in the Kane County Letter, for 1.6 miles on a public road."

38. R645-301-521.168 AREA 1, In accordance with the requirements of R645-301-521.168, the air monitoring stations specified in the recently issued Air Quality Approval Order Section II.B.5 were reportedly shown on Dwg 5-47, but could not be found on this map.

The labels for the air monitoring station have been modified to a larger size and a different color to aid in viewing. These labels can be found on Drawings 5-47 and 5-48.

39. This deficiency applies to areas 1, 2, and 3

The man caused disturbances from mining and mining related activities within the nesting and brood rearing and wintering (basically year-round) buffer will impact the entire north lease area. The total acreage of the proposed permit area is approximately 250 acres which translates into 1000 acres of compensatory mitigation given a ratio of 4 acres of mitigation for each acre of disturbance. It is appropriate to scale the requested habitat mitigation and population monitoring activities to the type and extent of foreseeable impacts associated with the mine application. This ensures fairness and increases the likelihood of attaining desired plan outcomes. The Utah Division of Wildlife Resources have indicated a willingness to cooperate with mine plan implementation, by such measures as carrying out habitat restoration funded by Alton Coal Development (ACD) and vetted through the Watershed Restoration Initiative. And, similarly, Southern Utah University personnel have indicated willingness to conduct appropriate population monitoring to help assess the sage-grouse responses to mine development, mitigation, and restoration activities, in a manner supported by ACD. Although this permit is not driven by the costs of restoration, it is only sensible to recognize that doing work of a certain scale and type will have certain costs. Constructive partnerships leverage available resources, and ACD will receive cost reductions and program efficiencies through these partnerships.

ACD will need to provide documentation of completion of 200 acres of mitigation of accessible brood rearing sage grouse habitat prior to approval of the portion of the North lease (SW Corner 51.9 acre parcel) referred to as area one currently under review. Documentation for the completion of mitigation for the remaining 700 acres of accessible sage grouse brood rearing habitat and 100 acres of riparian mitigation (subject to Army Corps requirements) for the proposed North Lease area will need to be completed prior to obtaining a permit to commence surface mining activities in that area. This collaborative determination is the result of review and comment and a series of meetings (10/22, 11/23, 12/2 and 12/3/2015) with DWR (Bill James, Ben Nadaloski, Avery Cook, Josh Pollock and Rhett Boswell), The Panguitch Local Sage Grouse Working Group (Dr. Nicki Frey), FWS (Lary Crist, Jay Martini and Betsy Herrmann).

REQUIRED MITIGATION for CURRENT MINING OPERATIONS:

DOGM in consultation with DWR, FWS and The Panguitch Local Sage Grouse Working Group (Dr. Nicki Frey) had suggested that:

Required mitigation for the Dames lease area should not be used for areas 1, 2 and 3 of the north lease. The area could have been used for alternative mitigation if it had been located outside of the Lekking, nesting and brood rearing buffer, not disturbed, impacted or highwall mined. This area was previously impacted by man caused disturbances when mining and mine related activities eliminated the lek and continued in the areas contiguous to and including the Dames lease area.

The Division was provided with documentation from ACD verifying highwall mining in the 88.5 acre parcel during the partial inspection conducted by Priscilla Burton in November of 2015. However additional information provided by ACD indicated that mining did not occur in the Dames lease (revised MSHA map). The Division has determined that although the area is permitted it has not been mined and that ACD can apply the Dames lease mitigation acreage of 344 acres to ....ACD will not be allowed to conduct mining or mining related activities in the Dames lease. The following commitment is suggested; ACD will provide for 344 acres of wet meadow brood rearing habitat prior to conducting mining or mining related activities in the dames lease.

There is a potential loss of sub-irrigation to the Dames lease. The current ground water monitoring data for that area indicates that the water level has dropped 7.5' to 12' (which will eliminate the sub-irrigation by the Spring of 2016 according to the Division's staff) that supported the wet meadow habitat and a critical food source for sage grouse chicks. ACD is currently required to maintain the wet meadow habitat.

ACD has also received non-compliance violations for not completing mitigation within allotted time frames including the 355 acre BLM parcel. The DOGM/BLM specifications for the 355 acre parcel have not been completed for the fourth time as verified by DOGM and BLM personnel(12/01/2015). ACD will need to pursue other alternatives for the 355 acres of mitigation treatment and provide documentation that it has been completed as provided for in the abatement options for NOV21161. Written verification of completion of the 443 acre WRI project 3419 will also need to be provided prior to conducting mining or mining related activities in the North Lease.

Once mining has commenced the man caused disturbances from mining and mining related activities within the nesting and brood rearing and wintering (basically year-round) buffer will impact the entire North Lease area.

Alton Coal Development will need to provide documentation of completion of 200 acres of mitigation of accessible brood rearing sage grouse habitat prior to approval of the portion of the North lease (SW Corner 51.9 acre parcel) currently under review.

As set forth in the attached letter to Associate Director Dean dated December 23, 2015, ACD objects to the allegations set forth in this comment and requests the Division to credit ACD with the full 344 acres of mitigation relating to the New Dame Lease area within the existing Coal Hollow Mine Permit towards its proposed disturbance in Area 1 of the North Private Lease Area. In addition, the Division should reject the unfounded conclusion set forth in this comment that the wet meadow habitat has been impacted in this area. This comment is rebutted by Dr. Petersen in his most recent progress report attached to that letter. "The Greater Sage-grouse Population Monitoring and Habitat Improvement, Alton-Sink Valley, Utah Progress Report for Year 2014-2015, at p. 26, Table 4. Mr. Petersen confirms, on the basis of his study of the wet meadow that its composition is similar to that of similar habitat types in the area. Progress Report at p. 2.

Finally, there is no basis for the premise of the comment for tying South Lease mitigation to the new proposed North Lease Area. The op and scatter mitigation project on 355 acres of BLM land is mitigation credited to the South Lease. Daron Haddock confirmed in a recent exchange that this mitigation project is separate from and does not affect the North Lease. Further, ACD is contesting the fact of violation number NOV 21161 regarding the lop and scatter mitigation project. This project is located on BLM land and BLM has set the terms and conditions of the mitigation project. The Division has failed to comply with BLM's terms and conditions by intentionally excluding the ACD from inspections and discussions regarding project compliance.

40. This deficiency applies to areas 2 and 3.

Documentation for the completion of mitigation for the remaining 700 acres of accessible brood rearing sage grouse habitat and 100 acres of riparian (subject to Army Corps requirements) for the proposed North Lease area will need to be completed prior to obtaining a permit to commence surface mining activities in that area.

The approved Appendix 3-8 details mitigation for Sage-grouse .

41. This deficiency applies to areas 1, 2 and 3

Monitoring

ACD will need to monitor impacts to wildlife and natural resources throughout the life of the mine and the 10 year reclamation liability period. The enhancement phase of the required protection and enhancement plan is implemented during the reclamation phase of mining operations. Representative statistical sampling using GPS collars for the Alton sage grouse population is estimated at a minimum of 5 and a maximum of 10 collars. Hens should be collared as an essential component of recruitment monitoring. Although 5 collars are not statistically adequate to publish the data collected; that is the number (Using a simple estimation (12 attending males =~ 15-24 hens or 25% of the hen population) preferred in light of variables associated with impacts to the sage grouse, (personal communication with DWR (Bill James, Avery Cook, Rhett Boswell), The Panguitch Local Sage Grouse Working Group (Dr. Nicki Frey) and BLM (Lisa Church).

Alton Coal will need to include in Appendix 3-8 a long term 5 year sage grouse monitoring plan. The plan shall include a written contract that includes the following information:

Funding and associated costs for the purchase of 3 global positioning system (GPS) tracking collars and the monitoring of 5; Associated costs will be defined in the terms of the contract that include at a minimum: supplying necessary operational funding to permit monthly data download from satellites, basic operational expenditures by qualified individuals involved in accessing, parsing, and ensuring minimal ground truthing and cleaning of locational data for the first 5 years of this mining permit operation.

A commitment to (1) analyze the data, (2) meet with Dr. Frey, DWR, DOGM, FWS quarterly and other members of the Panguitch Local Sage Grouse Working Group if needed and (3) provide a summary, analysis, findings and recommendations of the data from the 5 GPS collars.

With the habitat mitigation offered in the mine application, these population monitoring steps will take the mine through the first five years of operation in the North Private Lease area. Prior to the initiation of the second 5 year period, a new monitoring and assessment plan will be needed. ACD will need to provide a commitment to that effect. Although additional habitat restoration is not expected, continued monitoring of sage-grouse populations and habitat use will be required throughout the life of the mine and the 10 year reclamation liability period. Appendix 3-8 needs to include a monitoring plan for the 10 year reclamation liability period.

The application refers to the current (2015) sage grouse monitoring plan (Data collected in 2014 that was due in October of 2014, received by DOGM on January 23, 2015 that has not been approved. ACD will need to consult with the Division to determine the specific criterion for implementing the following components of the sage grouse management plan for the North lease area:

Employee Observations;
Monthly Bird Surveys;
GPS Collaring and Monitoring;
Noise Detection and Sound Assessment;
Habitat Mitigation;
Vegetation Improvements and Monitoring and;
Predator Control Activities.
Additional information may be required by DWR and or FWS.

ACD objects to this comment which attempts to unilaterally impose mitigation measures and costs on Alton Coal which are contrary to its Mitigation Plan and Permit Conditions. Alton Coal has committed to contribute $8,000 towards monitoring in addition to the cost of regular monthly surveys conducted by Dr. Petersen and ACD employee sighting reports. Greater Sage-Grouse Management Plan, North Private Lease at p. 12. These funds can be used to fund collars or other monitoring activities or to fund research by Dr. Frey or others.

Currently, Alton Coal funds Dr. Frey's monitoring and research for two GPS collars not the 5 to 10 collars unilaterally imposed by Mr. Helfrich's deficiency comment. November 24, 2015 Progress Report at p. 16.

Mr. Helfrich's comments recommending this additional collaring should be disregarded as they are directly contrary to the terms of the Coal Hollow Mine permit. Similarly his requirement that the operator extend their contract for 5 years with Dr. Frey is unacceptable. These recommendations were developed by Mr. Helfrich without the consultation with or agreement by Alton Coal.

By the terms of the Coal Hollow Permit Renewal dated November 8, 2015, Alton Coal agrees to "cooperate with the Division in consultation with the state and federal wildlife agencies to develop reasonable practices and methods as are determined to be necessary to implement the plan and to measure success and to achieve the goals of the [Alton Sage-Grouse Habitat Protection] plan." Permit Stipulation Exhibit A, No. 6, Permit Renewal dated November 8, 2015.

Mr. Helfrich has bypassed the operator and unilaterally recommended a 5-year contract with Dr. Frey and the funding of 5 to 10 collars and these recommendations must be rejected. The proposed Management Plan incorporates reasonable practices and methods needed to implement the plan and measure success and should be approved as currently proposed.

42. R645-301-231.100 and R645-301-232.600 AREA 1, Although ACD stated in the 12/18/2015 cover letter that they had updated Section 231.100 and Section 523, explicit soils handling information could not be found in the narrative. An approach that was discussed and agreed upon with ACD on 12/15/2015 could not be found in the update. To meet the requirements of R645-232.600 Timing and R645-301-232 Topsoil and Subsoil Removal, the following points were agreed upon and should be included in the narrative:

1. The A horizon (topsoil) will be salvaged along with B horizon (subsoil) to a depth of 14 inches (1.2 feet) from all active mining areas (pits, roadways, haulroads, storage and repair yards, etc.) including the location of the proposed county road relocation. The only exception is that topsoil can remain under topsoil storage and subsoil storage piles, if the existing surface is delineated in some way.
2. In all active mining areas, including county road relocation area, the remaining subsoil (the B & C horizon above lithic contact, approximately 2.6 feet) will also be removed and stockpiled in a subsoil stockpile.
3. The remaining B & C subsoil may be protected in place beneath stockpiles (topsoil, subsoil, and spoil stockpiles) by using a marker fence to delineate the subsoil surface on 100 ft centers and by using gps survey grid of the topography of the subsoil surface layer. This subsoil will be recovered at reclamation to create the cover depth required over the spoil.

(Spoil will be sampled for suitability, since spoil will make up 0.2 feet of the required 4 feet cover depth.)
4. A soil scientist will monitor the topsoil and subsoil removal and placement of geomarker.
5. A surveyor will map the surface elevation of the subsoil being protected in place.
Thus, the plan should indicate that prior to mining Pit 1, topsoil will be removed from all of Area 1 except beneath the topsoil and subsoil pile locations. The plan should also indicate removal of subsoil (B & C horizon) from all of Area 1 except beneath the topsoil and subsoil pile locations. In addition specify the area in acres to be stripped of topsoil prior to mining Pit 1/Area 1 on Dwg 2-4 or in the narrative or both so that volumes can be determined. Specify the method (equipment) to be used to strip the topsoil and subsoil and to create the stockpiles prior to mining in Area 1. Specify the size volume of the subsoil stockpile on Drawing 2-4.

According to the above and subsequent discussion and a meeting on 1/12/2016 with P. Burton of the Division, Drawing 2-4 and sections 523 and 231 have been modified to describe the soils handling plan and methods specifically related to Permit Area 1. Soil volumes have been amended accordingly.

43. R645-301-234.230 and R645-301-232.500 AREA 1 (and all future areas of NPL), Section 244.100 describes measures to be taken to stabilize stockpiled soils. The current practice of allowing stockpiles to sit a year or more before seeding and/or applying tackifier has not provided adequate protection to the topsoil or subsoil stockpiles, because there is too much uncertainty involved in the duration of the stockpiles. Please revise section 244 to indicate that the temporary topsoil and subsoil stockpiles will be surface roughened and seeded immediately. Please indicate that the temporary spoil pile will be roughened and a tackifier applied to the outslope as the pile rises. The cover letter indicates Section 244.100 was modified as described above, however no changes were noted in the narrative provided to the Division on 12/18/2015.

An old version of Chapter 2 was mistakenly shared with DOGM, the updated version has been shared with the updated text.

44. R645-301-231.400 and R645-301-232.600 AREA 1 (and all future areas of NPL), Section 232.720 describes replacement depths of 13 inches of topsoil over 31 inches of subsoil. Chap 2 should provide an inventory in table form of topsoil and subsoil salvage volumes by Area 1, Area 2 and Area 3 and a proposed method of tracking those volumes as mining progresses. The cover letter indicates Section 232.100 was modified as described above, however no changes were noted in the narrative provided to the Division on 12/18/2015.

An old version of Chapter 2 was mistakenly shared with DOGM, the updated version has been shared with the updated text.

45. R645-301-132 and R645-301-230 Area 1 (and all future areas of NPL), The soil survey presents a complicated map of the soils within Area 1, 2, and 3. A soil scientist is required to interprete the mapping during soil salvage of all areas, including Area 1. Please clarify the plan to state that a soil scientist will be present during topsoil and subsoil salvage in all areas, including Area 1. The cover letter indicates Section 231.100 was modified as described above, however no changes were noted in the narrative provided to the Division on 12/18/2015.

An old version of Chapter 2 was mistakenly shared with DOGM, the updated version has been shared with the updated text.

46. R645-301-234.230, AREA 1, The plan must specify that after additions to topsoil and subsoil piles are made, they will be reshaped, bermed and seeded at the end of placement or by December 31st of each year, whichever comes first. The cover letter indicates Section 234.230 was modified as described above, however no changes were noted in the narrative provided to the Division on 12/18/2015.

An old version of Chapter 2 was mistakenly shared with DOGM, the updated version has been shared with the updated text.

47. This deficiency applies to areas 2 and 3
A monitoring frequency for the proposed reference areas V03, V05 and V06 and site V22 during the reclamation liability period;

Monitoring frequencies have been proposed on page 48 in Vol. 12 of the MRP

48. This deficiency applies to area 1
Vegetation map #2 should be updated to include Area V22 and; A commitment to mitigate impacts to these wetland riparian vegetation communities located along Kanab creek below the southern end of the permit boundary.

Area V22 has been added to Vegetation map #2. A commitment to mitigate impacts to these communities has been made on page 48 in Vol. 12 of the MRP

49. Area 1:
R645-301-527.100, -527.200: There is no clear designed access to the permit area off K3900 for operations limited to within Area 1 on Drawing 5-60.

A 28' wide access roadway from County Road 136 (K3900) to the Southern Haul Road has been designed and added as shown on Drawing 5-60. This access is also depicted on Drawings 5-47, 5-48 and others where appropriate.

50. R645-301-526,-527.220: The Permittee failed to include copies of the USACE NWP-14 approval and pre-construction notification in Appendix 5-12.

A copy of USACE NWP-14 has been included in Appendix 5-14

51. Area 1:
R645-301-521.170, R645-301-527.220: The application is missing a copy of the pre-construction notification and USACE 404 NWP-14 to demonstrate that all other applicable state and federal regulations have been met.

A copy of USACE NWP-14 has been included in Appendix 5-14

52. R645-301-232.600: The Permittee failed to clarify the narrative as described in Chapter 5 section 521.170 in regards to the soil salvaging for Area 1 with the development of Pit 1. The narrative needs to either describe the process or at least reference the appropriate Chapter 2 narrative. The Permittee did amend the last paragraph to state that topsoil and subsoil will be salvaged for all active surface mining areas that will be developed, regardless of the temporary nature, including roads.

Added reference in 521.170 to 231 and 523. See response to deficiency #42.

53. Area 1:
R645-301-512.240,-532:The Permittee did amend text within Chapter 5 Section 512.240 to address the ponds within the North Private Lease, however, the narrative is still missing a discussion stating the specific Area 1 features are currently under review.

Amended as requested.

54. R645-301-532: The Permittee added details addressing how drainage off the eastern part of Area 1 will be treated and controlled off the disturbed area by a berm and silt fence on Drawing 5-48, however, such drainage features need to be depicted on Drawing 5-65 as well.

Drawing 5-65 amended as requested.

55. Area 1:
R645-301-521.143:The Permittee will amend Drawing 2-4 to show the hatch indicating topsoil and subsoil recovery to extend below the entire extent Area 1 between Pit 1 and the area expected to be disturbed by the construction and maintenance of the topsoil, subsoil, and spoil piles. Corresponding volumes of topsoil and subsoil will be updated to account for the addition soil. The Permittee failed to adequately address deficiency # 59 in the December 18, 2015 submission. The application does not meet the minimum requirements of R645-301-521.143 due to missing text referencing and detailing the specific operations to be utilized within regards to the temporary excess spoil pile on the North Private Lease during Pit 1 development.

Added reference in 521.143 to 231 and 523. See response to deficiency #42.

56. The amendment does not meet the State of Utah R645 requirements for Water Rights and Replacement. The following deficiency must be addressed prior to final approval:
R645-301-727, R645-301-731.800: An updated analysis on Water Rights and Replacement must be completed to determine the total volume of state appropriated groundwater and surface water within and adjacent to the North Private Lease. Baseline hydrologic information must be supported with a hydrogeologic groundwater model of the alluvial aquifer within and adjacent to the North Private Lease.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

57. R645-301-731.112; R645-301-731-121: Backfilling Tropic Shale in Pit 20 and Pit 21 will increase TDS in the alluvial aquifer. The amendment must address how earth materials will be handled to protect groundwater quality and prevent the harmful infiltration of increased TDS into the alluvial aquifer.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

58. R645-301-731.211; R645-301-731.212: The application must provide a monitoring plan for alluvial groundwater discharged into the open-pits. Ground-water will be monitored and data will be submitted at least every three months.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

59. R645-301-731.112: The amendment must demonstrate ground-water quantity in the alluvial aquifer will be protected during open-pit mining using a hydrogeologic groundwater model of the alluvial aquifer that rests within and is adjacent to the North Private Lease.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

60. AREA 1:
The amendment does not meet the State of Utah R645 requirements for Sediment Control Measures. R645-301-742: The amendment must provide designs and calculations demonstrating runoff will be reduced and sediment will be retained within ASCA-1 through the use of an effective erosion control treatment. Supporting calculations must show the Alternative Sediment Control Area measure will capture the calculated sediment yield of 28.14 (tons/ac)/yr in ASCA-1. The amendment must provide a design of the treatment structures as they will be installed in the drainage ditches. The supporting narrative must define a level at which trapped sediment will be cleaned out from behind the treatment structures.

Appendix 5-12 has been amended to include calculations for runoff and sediment for ASCA-1 and refers to the location of typical design of treatment structures. Also, Appendix 5-12 includes cleanout frequencies for the treatment structures.

61. AREA 2-3:
The amendment does not meet the State of Utah R645 requirements for Water Quality Standards in Area's 2 and 3. R645-301-751, R645-301-752.230: Based on conversations with the Division of Water Quality it is determined decant effluent from Pond #7 may not flow through the disturbed permit area and mix with ASCA-1 effluent. Sediment Pond #7 decant effluent must be piped separately under the haul road and county road and sampled at the edge of the permit boundary.

By comparison of Drawings 5-69 and 5-47 and the ASCA-1 designs in Appendix 5-14, the current design allows for separate testing of effluent streams from both Pond #7 and ASCA-1. Pond #7 can be tested immediately downstream from the emergency/primary spillway before entering culvert C-2 as the ground between the spillway and C-2 will remain undisturbed. Effluent from ASCA-1 can be tested as it cascades over the straw bales and into the drop box structure above C-2.

62. R645-301-742.320: The amendment does not meet the State of Utah R645 requirements for the Diversion of Perennial Streams that drain a watershed of at Least One Square Mile.
The amendment must provide a certified engineered design of Kanab Creek reconstruction after the haul road crossing is removed.

The haul road crossing from the NPL Area 2 to Area 3 occurs at Culvert C-3. As flow for Kanab Creek will be directed through the culvert, no diversion has been proposed and this rule does not apply. However, The design specifications for Culvert C-3 are in draft form and will remain under review as part of the USACE Individual 404 permit application process with the USACE as primary signatory. These draft designs have been included as Appendix 5-15.

63. R645-301-742.330: A narrative is needed justifying the boundary of the undisturbed watershed UA-4 in Drawing 5-66.

Appendix 5-12 has been modified as requested. See paragraph 1 on pg. 2.

64. AREA 1:
R645-301-742: The amendment does not meet the State of Utah R645 requirements for Sediment Control Measures. The amendment must include a narrative for controlling sediment during the construction of Sediment Ponds 6 and 7.

Chapter 7 section 742.110 has been amended to include sediment control measures to be implemented prior to construction of ponds.

65. AREA 1:
R645-301-742: The amendment must include a narrative in the amendment detailing the sediment control measures along the eastern boundary of Area 1.

Text with a reference to the location of sediment control measures to be used along the eastern boundary of Area 1 has been added to Chapter 7, section 742.110.

66. R645-301-742.220: The amendment must include an engineered design with supporting calculations of the open-pit dewatering system for the maximum expected volume of 360,000 gpd to Sediment Pond #7.

This rule requires adequate sizing of ponds. Pond 7 has been engineered to contain the 10 year 24 hour plus a hypothetical 360,000 gpd of dewatering water and still not discharge. Appendix 5-12 shows that the expected dewatering rates will be considerably smaller than 360,000 gpd, thus Pond 7 is adequately sized.

67. R645-301-742.323; R645-301-744.100: The amendment does not meet the State of Utah R645 requirements for Diversions and Discharge Structures.
The amendment must include a narrative with supporting calculations for the post-mining topography of permanent diversions that drain miscellaneous flows from the height of the fields bordering Kanab Creek down to the elevation of Kanab Creek.

Appendix 5-12 has been modified to include a full section on Reclamation Hydrology. Drawing 5-79 has also been added to illustrate these designs and calculations.

68. R645-302-316.500, The plan should take note of this requirement for placement of water bodies during and following mining in prime farmland designated areas.
Inserted R645-302-316 into Chapter 2.
Inserted the following sentence in section 316.100 -

The planned post mining land use for all prime farmlands disturbed during mining will be for the same agricultural use as prior to mining.
Inserted the following sentence at the end of section 316.500 -
All planned water bodies will be constructed during or following mining in non-prime farmland portions of the permit area.

69. AREA 1:
The amendment does not meet the State of Utah R645 requirements for Sedimentation Ponds. R645-301-742.221.33; R645-301-742.221.36; R645-301-742.224; R645-301-742.225.1: The amendment must provide a detailed, clear and concise operation plan for the total containment sediment ponds 5 and 6. See Analysis for total containment requirements.

Appendix 5-12 details how ACD will maintain ponds 5 & 6 as total containment structures.

70. R645-301-121.200, -521: The Permittee will add text detailing that areas where Phase 1 through Phase 3 bond release is held will be staked and marked at all times.

Amended text in section 521.250 that all permitted and bonded area perimeters will be clearly marked as a "disturbance boundary."

71. R645-301-521.167: The permittee will clarify the narrative with Chapter 5 Section 521.167 to address the blasting consultant and plan included within the application.

Clarified text in 521.167 as requested.

72. R645-301-524.320 During a Divisions cursory review (see attached figure), it appears that there are some type of ranching structures directly west of the proposed permit boundary that are within one half mile that have not been identified by the Permittee. These structures would fall under the preblast survey requirements. Also, while the structure identified on Drawing 1-7 is just outside of one half mile (about 40 feet), the Division would recommend that a preblast survey still be offered to the structure owner.

Two structures (Pole Barn & Fish Pond with earthen dam) were identified within the ½ mile radius as shown on modified drawing 1-7. Narrative was amended in 524.320 to account for these structures and also to offer survey to 5 nearest properties in Alton town prior to any blasting in Permit Area 2.

73. R645-301-524.641 The sections discussing airblast and ground vibration monitoring should be updated and re-evaluated to include potential monitoring and establishment of a maximum allowable limit on the ground vibrations at structures located within one half mile of the permit boundary, specifically the ranching structures located west of the permit boundary.

Also see response to Deficiency #72. Text in 524.630 and .641 was amended to include monitoring requirements of airblast and ground vibration for each Permit Area. These requirements include proposed monitoring locations and a PPV limit.

74. Area 1:

R645-301-521.163: there is no clear narrative or reference to a narrative that details what pits will be bonded for within Area 1 as the approved permit area.

Section 521.163 modified as requested.

75. Deficiency R645-301-412.200, AREA 2, Buried irrigation pipe in Greta and Orval Palmer's property is described in Section 521.122 of the MRP and shown in Figure 12 of App. 7-16. There is nothing specified in Exhibit 16 (the Palmer's lease) with regard to replacing this irrigation system. Therefore, Appendix 4-7 must include a statement from Greta and Orval Palmer regarding the replacement of agricultural water lines in Tract 9-6-12-3.

*Appendix 4-7 contains information regarding cultural resource for the NPL. However, Page 4-2 contains the following commitment "*After reclamation, the mining area will be restored to support uses it was capable of supporting prior to mining. Vegetation will be restored to provide habitat and a food source for wildlife. Access roads, fence lines, and supporting structures will be reconstructed pursuant to the wishes of the surface landowners". *This would include the Palmer's irrigation system.*

76. The information in the application is not adequate to meet the requirements of this section of the regulations. Prior to approval the following information is required in accordance with R645-301-342; ACD will need to provide a commitment to implement the criterion included in the sage grouse management plan for the North lase area during the reclamation liability period.

See response to Comment #41.

77. R645-301-553: Rewrite narrative to show understanding of R645-301-553 that rough backfill and grading will follow within 60 days of coal removal.

Narrative in 553 modified to show commencement of backfill in pits within 60 days of coal mining conclusion.

78. Coal Hollow Mine:
R645-301-513.500, R645-301-529, R645-301-551: The Permittee will amend Chapter 5 Section 513.500 to include the reclamation of the underground portals within Pit 10 by backfill of approximately 135 ft of vertical backfill, meeting MSHA 30 CRF 1711-2 requirements. The portals need to be called out on Drawing 5-37A detailing the backfill as the seal.

This amendment deals with changes in the MRP directly stemming from proposed activities in the North Private Lease permit area. The comment above will be addressed as part of the ongoing review of Pit 10 backfill requirements associated with NOV 21164.

79. R645-301-233.100, AREA 1 (and all future areas), In addition to spoil sampling, Section 232.500 describes subsoil sampling prior to removal and stockpiling. Locations of proposed substitute subsoil sampling should be identified on Drawing 2-4, Topsoil Handling Plan. The 12/18/2015 response did not add language in Section 232.500 and Section 232.700 as described in the cover letter and did not

provide a sampling grid. In addition the narrative was not corrected as discussed to change `every 2 to 5 acres' to1every 2.5 acres'.

Drawing 5-76A has been modified to show the sampling grid for Permit Area 1 based on 2.5 acre centers. Narrative in sections 232.500 and 232.700 modified accordingly.

80. R645-301-731.300 AREA 1 (and all future areas). To ensure four feet of suitable material is within the root zone, Section 232.500 of the plan includes sampling of the replaced overburden (spoil). This plan currently is ambiguous about sampling frequency (`every 2 to 5 acres'). The plan should state that a sample will be taken on a grid every 2.5 acres, on a grid with collection of gps data for the sample location. The plan does not identify what parameters are to be analyzed. The plan states the spoil will meet the suitability requirements for topsoil, but to be clear and avoid misunderstanding, the plan should identify analysis for the parameters outlined in Table 3 and Table 7 of the Utah Guidelines for Overburden and Topsoil Handling. Should a sample analysis indicate spoils are poor or unacceptable, the plan must describe a contingency for further sampling within the 2.5 acre area to delineate the extent of the unsuitable spoil. The plan should also suggest a mitigation plan for unsuitable spoil. The 12/18/2015 response did not change language in Section 232.500 and Section 232.700 from `every 2 to 5 acres' to `every 2.5 acres', as described in the cover letter and did not provide a sampling grid or a contingency for further sampling should results come back `poor to unacceptable.'

Drawing 5-76A has been modified to show the sampling grid for Permit Area 1 based on 2.5 acre centers. Narrative in sections 232.500 and 232.700 modified to address what parameters will be analyzed and the procedure to be followed to ensure four feet of suitable material is within the root zone.

81. R645-301-121 AREA 1 (and all future areas), The last three paragraphs in Section 232.500 do not pertain to the North Lease and therefore, those paragraphs should be specifed as pertaining only to the Coal Hollow MIne sampling plan. The 12/18/2015 response did not change language in Section 232.500 as described in the cover letter

A revised copy of Chapter 2 text has been submitted with the amended text.

82. R645-301-242.100 AREA 1 (and all future areas). MRP Section 242.200 currently states that the regraded land will be treated if necessary to reduce potential slippage of the redistributed material and Section 341.220 states that an environmental professional will determine whether ripping is required. However, neither section addresses the treatment of replaced subsoil. Section 242.200 requires modification to state that when subsoil placement is not immediately followed by topsoil placement (within a month), the graded subsoil will be treated with mulch or tackifier (per Section 244.200) to prevent erosion in the interim; and the subsoil will be ripped to a depth of 18 inches prior to topsoil placement. The 12/18/2015 response did not change language in Section 242.200 as described in the cover letter

A revised copy of Chapter 2 text has been submitted with the amended text.

83. R645-301-243, AREA 1 (and all future areas). Section 243 plans for composite sampling of replaced topsoil every 2 acres at final reclamation. The composite sample will be analyzed for N:P:K . This sampling will be completed within three months of topsoil placement. The 12/18/2015 response did not change language in Section 243 as described in the cover letter

A revised copy of Chapter 2 text has been submitted with the amended text.

84. R645-301-234.230, AREA 1 (and all future areas). The plan will include a topsoil/subsoil balance table that is updated as reclamation progresses and which is provided to the Division at year end. The 12/18/2015 response did not add a table in Section 234.230 as described in the cover letter.

A revised copy of Chapter 2 text has been submitted with the table added to Section 234.230.

85. R645-301-234.230 and R645-301-242.130, AREA 1 (and all future areas). Please describe the process of to be followed when a portion of the topsoil is utilized and a portion remains in the topsoil stockpile. How will the remaining topsoil be protected and in what time frame? The 12/18/2015 response did not change the narrative in Section 234.230 as described in the cover letter. In any case the proposed change to the narrative is not entirely acceptable, because it contains vague wording such as `reasonable time period following end of use,' and refers to Section 341.100 which does not describe seeding windows, and describes waiting until the next appropriate season. A definite date by which seeding would be accomplished is preferable.

A revised copy of Chapter 2 text has been submitted with amended text with procedure for protecting partially utilized topsoil stockpiles.

86. R645-301-521.133 & R645-103-.224.422, R645-301-526, R645-301-542.600: The Permittee failed to provide written proof of measures to be used to ensure that the interest of the public and landowners affected are protected with the realignment of K3100. (e.g. A letter communicating the ownership of the road, maintenance, bonding, and use of K3900 and K3100 by the public needs to be provided to the Division.) There is no written finding in regards to K3100 within not requiring the same level of proof Grant of Easement, Permit and Design by Kane County DOT, no proof of public notice, and no written statement from Kane County waving the requirement of such measures.

See response to Deficiency #37.

87. R645-301-553: The Permittee will describe the incremental bonding by pit and reclamation in the appropriate sections.

See response to Deficiency #33.

88. R645-302-317.622, R645-302-317.627 and R645-302-317.628 require the the Division consult with the NRCS State Conservationist for the reference crop and the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

This item applies to Area 2 and is not applicable to Area 1. This item has been evaluated by DOGM and NRCS. ACD has not received a plan to review.

89. R645-301-244 AREA 1 (and all future areas), The use of mulch is described as being one of three methods: straw, hydromulch or a sterile nurse crop. In past practice, the Permittee has utilized certified weed free straw and a quick growing sterile nurse crop and an application of nutrimulch (Turkey manure) to stabilize and fertilize the reclaimed surface. Section 244 should be revised to accurately

state the revegetation practices found to be successful at the Coal Hollow Mine and which will be applied in Area 1, keeping in mind the prevalence of clay soil texture. The 12/18/2015 submittal did not include the changes to Section 244.200 as described.

Additional text has been added to Section 244.200.

90. R645-301-242.200, AREA 1 (and all future areas), Section 242.200 describes treating the regraded land, as necessary, to reduce slippage of subsoil and topsoil. There have been instances of slippage of the subsoil and topsoil on excess spoil pile slopes (3h:1v). The plan must include routine ripping of the regraded spoil prior to subsoil placement on all slopes 3h:1v or steeper and on all areas compacted by traffic. The 12/18/2015 response suggests a misunderstanding of what is being requested. Please contact the Division to discuss this requirement for ripping of spoil prior to placement of subsoil
onto compacted spoil or graded land with slopes greater than or equal to 3h:1v.

Additional text has been added to Section 244.200.

91. R645-301-532.200, AREA 1 (and all future areas), An operational plan for stabilizing the laid-back alluvium/shale material to promote a reduction in the runoff is required to reduce the rate and volume of runoff into and through working areas during operations and reclamation.

Modified narrative in 532.200 as requested.

92. R645-301-121.200: The Permittee will correct errors with discrepancies of the Topsoil stock pile and subsoil stock pile labels changing throughout the Chapter 5 drawings.

Drawings modified as requested.

93. R645-302-317.220, The Division will use the soil-reconstruction specifications of R645-302-317.210 to carry out its responsibilities under R645-302-310 through R645-302-316 and R645-301-800. Soil reconstruction specifications must be considered adequate prior to approval.

ACD assumes that the Division will carry out its responsibilities.

94. Area 1:
R645-301-830.140: Pit 11 has surface disturbances associated with it and is not bonded for. There is only one culvert bonded for but two shown on the drawings. Missing narrative for the sequencing of bonding shown within Appendix 8-1.

In previous calculations, length of culverts of the same size had been combined for simplicity. These calculations have been modified to show each individual culvert and to show greater clarity in which Permit Area the different facilities must be bonded for. Appendix 8-2 has been amended to detail the incremental bonding sequence in relation to construction activities for Permit Area 1. Also added discussion regarding interaction with Pit 11.

95. The MRP does not contain any reference to the R645-302-240 regulations for auger mining operations. The Permittee shall add discussion to the relevant chapters detailing how the Augur mining rules -240 through -245.500 are met for the North Private Lease.

The requested information is found in Appendix 7-16 on pages 41-42.

96. R645-302-240: The application does not include a written commitment to Special Categories of Mining R645-302-240 Auger Mining and Remining Operations in the North Lease area. The rules require an evaluation of the proposed auger mining areas and any potential mitigative measures that need to be addressed. These rules include, but are not limited to: R645-302-241.200, R645-302-242, R645-302-243, R645-302-244.200, R645-302-245.110, R645-302-245.120,R645-302-245.130, R645-302-245.210, R645-302-245.220, R645-302-245.221, R645-302-245.222, R645-302-245.230,R645-302-245.231, R645-302-245.232, R645-302-245.300

The requested information is found in Appendix 7-16 on pages 41-42.

97. R645-301-722: The application does not provide planned locations of highwall mining locations in Appendix 7-16 Figure 3.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

98. R645-302-332: The application does not include a written commitment to Special Categories of Mining R645-302-332. Application Contents for Operations Affecting Designated Alluvial Valley Floors.

Eighteen additional monitoring wells have been drilled and analyzed in the North Private Lease area to characterize the Alluvial Groundwater System. Information on these wells, pump testing, monitoring plans and recommendations are compiled in the new Appendix 7-18.

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R645-301-500

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Highwall Mining Details (5-41 to 5-44)

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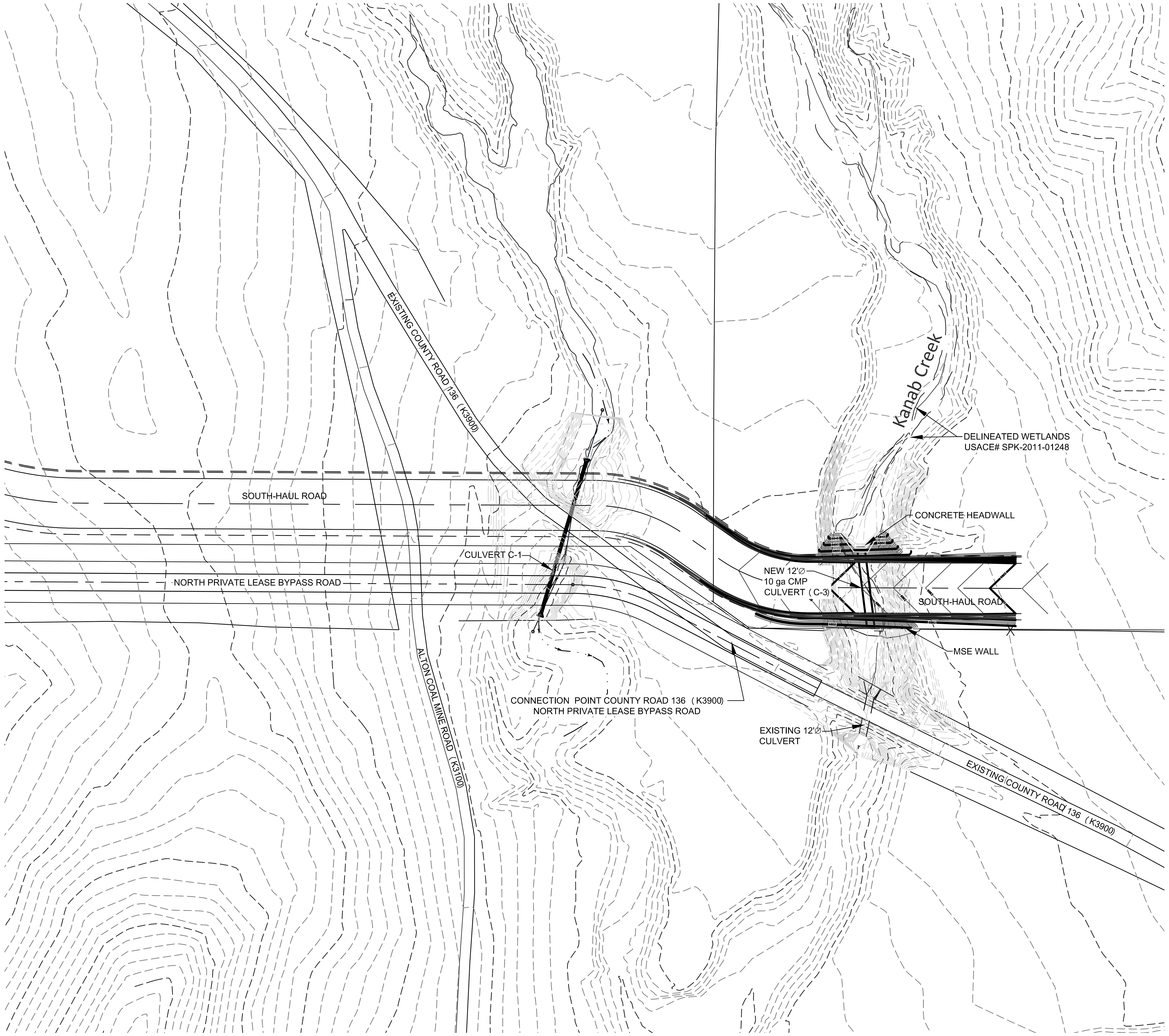
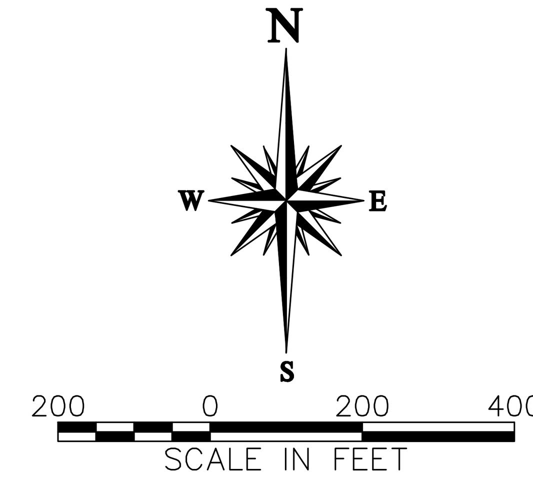
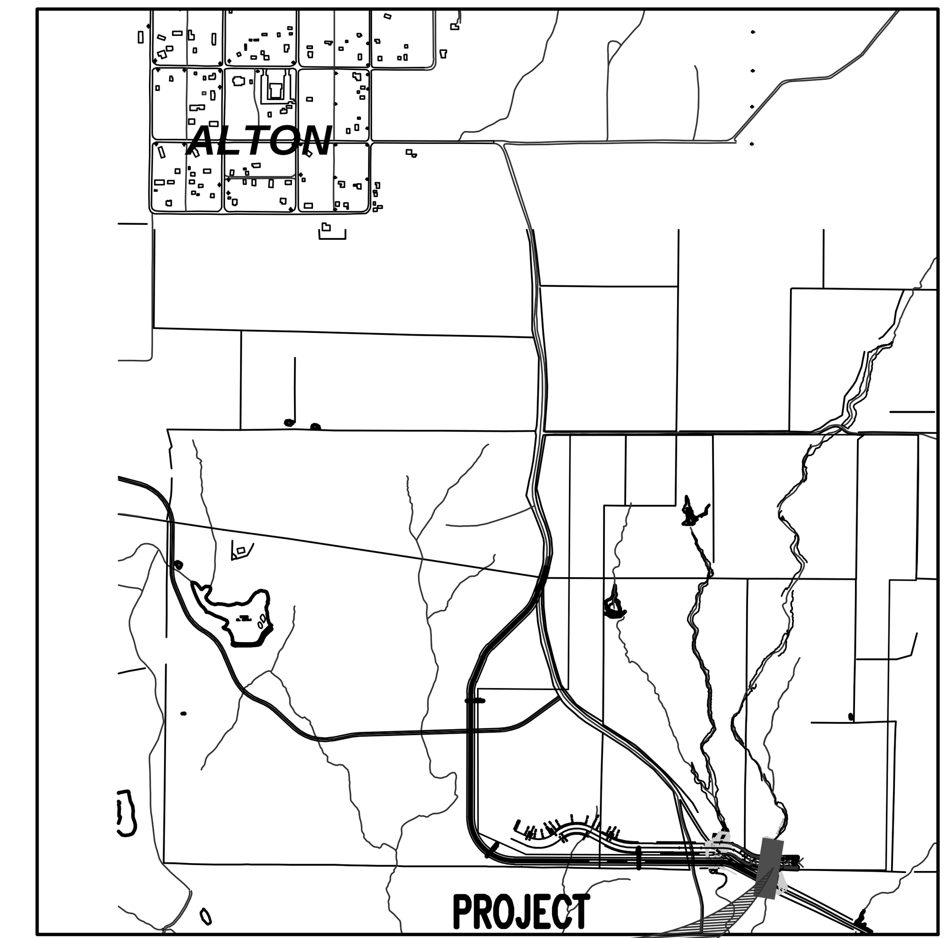
Culvert Design for Culvert C-3

(North Private Lease Area)







VICINITY MAP

(NO SCALE)

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C-C1	COVER SHEET
C-P1	PLAN AND PROFILE 12'ø CULVERT
C-P2	CULVERT AND HEADWALL PLAN AND PROFILE
C-P3	CULVERT HEADWALL & WING WALL DETAILS
C-P4	MSE RETAINING WALL PLAN AND PROFILE
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C-P6	RESTORATION/MITIGATION PLAN

ALTON COAL DEVELOPMENT LLC.
NORTH PRIVATE LEASE BYPASS ROAD AND SOUTH HAUL ROAD
KANAB CREEK CULVERT C-3

LOCATED IN SECTION 13, T 39 S, R 6 W, SLB&M
KANE COUNTY, UTAH
DECEMBER 2015

AVOID CUTTING UNDERGROUND UTILITIES. IT'S COSTLY.
Call BEFORE YOU Dig
1-800-662-4111
UNDERGROUND SERVICE (USA)

NOTICE!
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION, PROTECTION, AND RESTORATION OF ALL BURIED OR ABOVE GROUND UTILITIES, SHOWN OR NOT SHOWN ON THE PLANS.

NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT KANE COUNTY STANDARDS.

REVISIONS

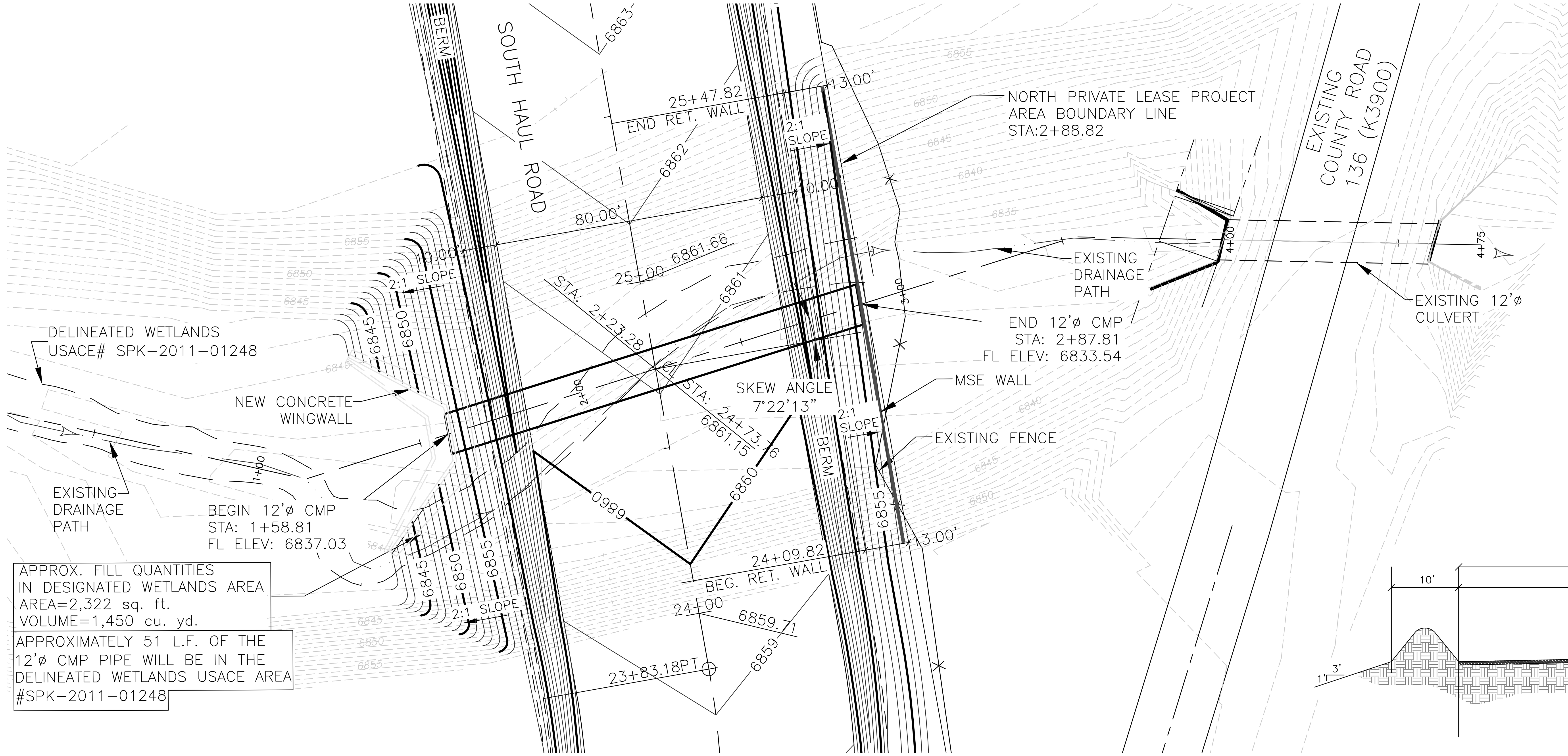
NO.	DESCRIPTION	DATE	BY
1	MOVED ROAD N&W PER A.C.	8/28/15	SWB
2	ADDED MITIGATION PLAN	2/16/16	SWB
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

COVER SHEET
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT C-3
LOCATED IN SEC. 13, T39S, R6W, SL.B. & M.
KANE COUNTY, UTAH

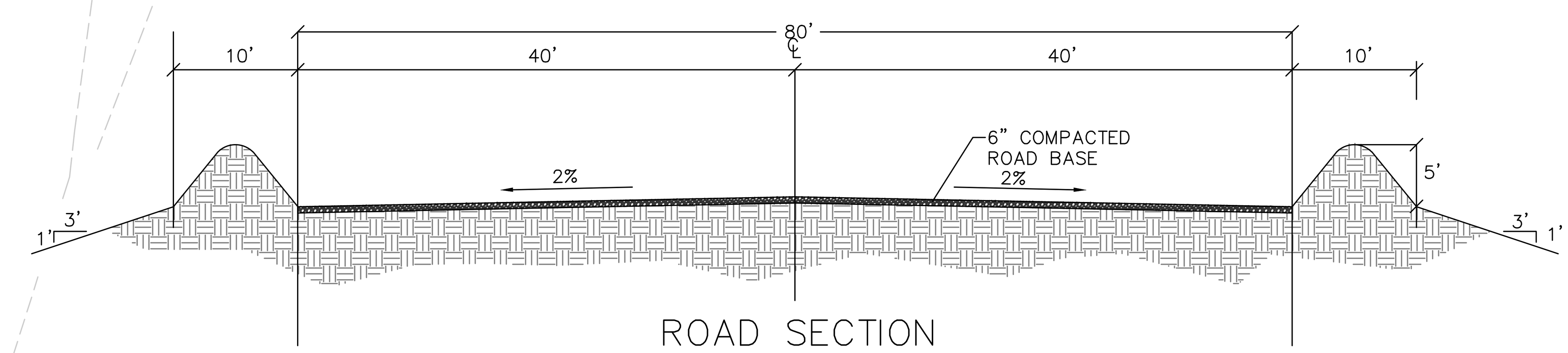
PROFESSIONAL STRUCTURAL ENGINEER
MARC L. BROWN
170223
06-24-16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=200'
SHEET NO. : C-C1



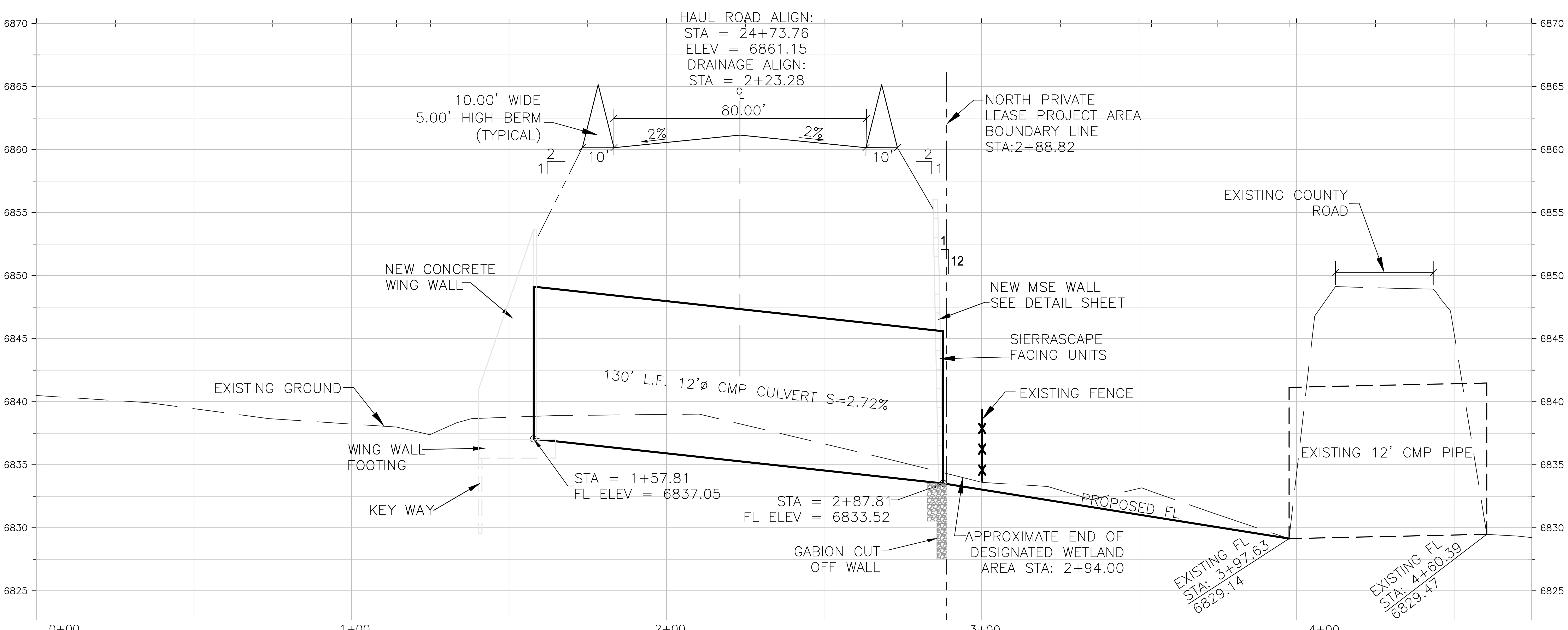
PLAN

SCALE: 1"= 20'



ROAD SECTION
80' HAUL ROAD

SCALE: 1"=10'



PROFILE

SCALE: HORZ. 1"= 20'
VERT. 1"= 5'

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Call BEFORE YOU Dig
1-800-662-4111
UNDERGROUND SERVICE (USA)

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REVISIONS

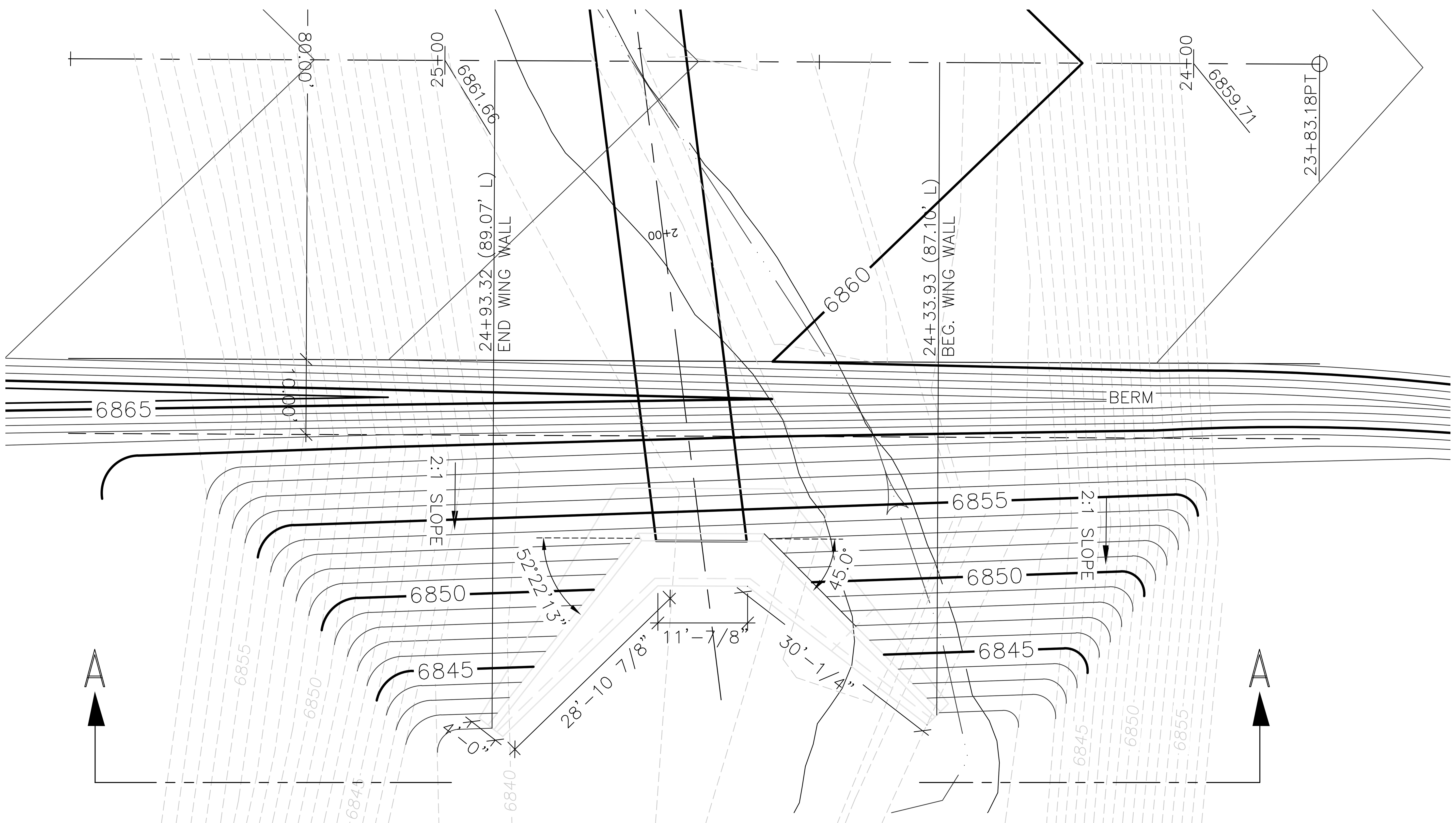
NO.	DESCRIPTION	DATE	BY
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

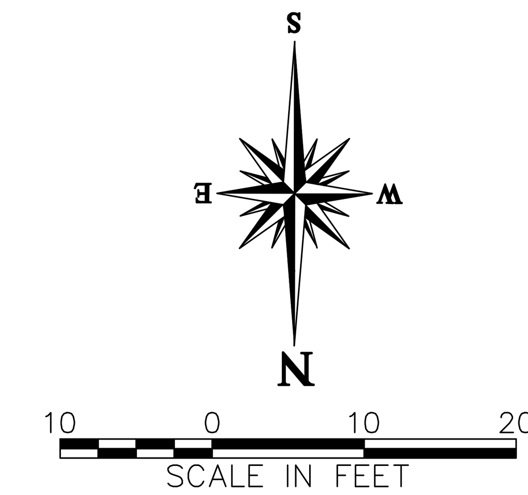
PLAN AND PROFILE
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT C-3
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PROFESSIONAL STRUCTURAL ENGINEER
MARC L. BROWN
6-24-16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=20'
SHEET NO. : C-P1

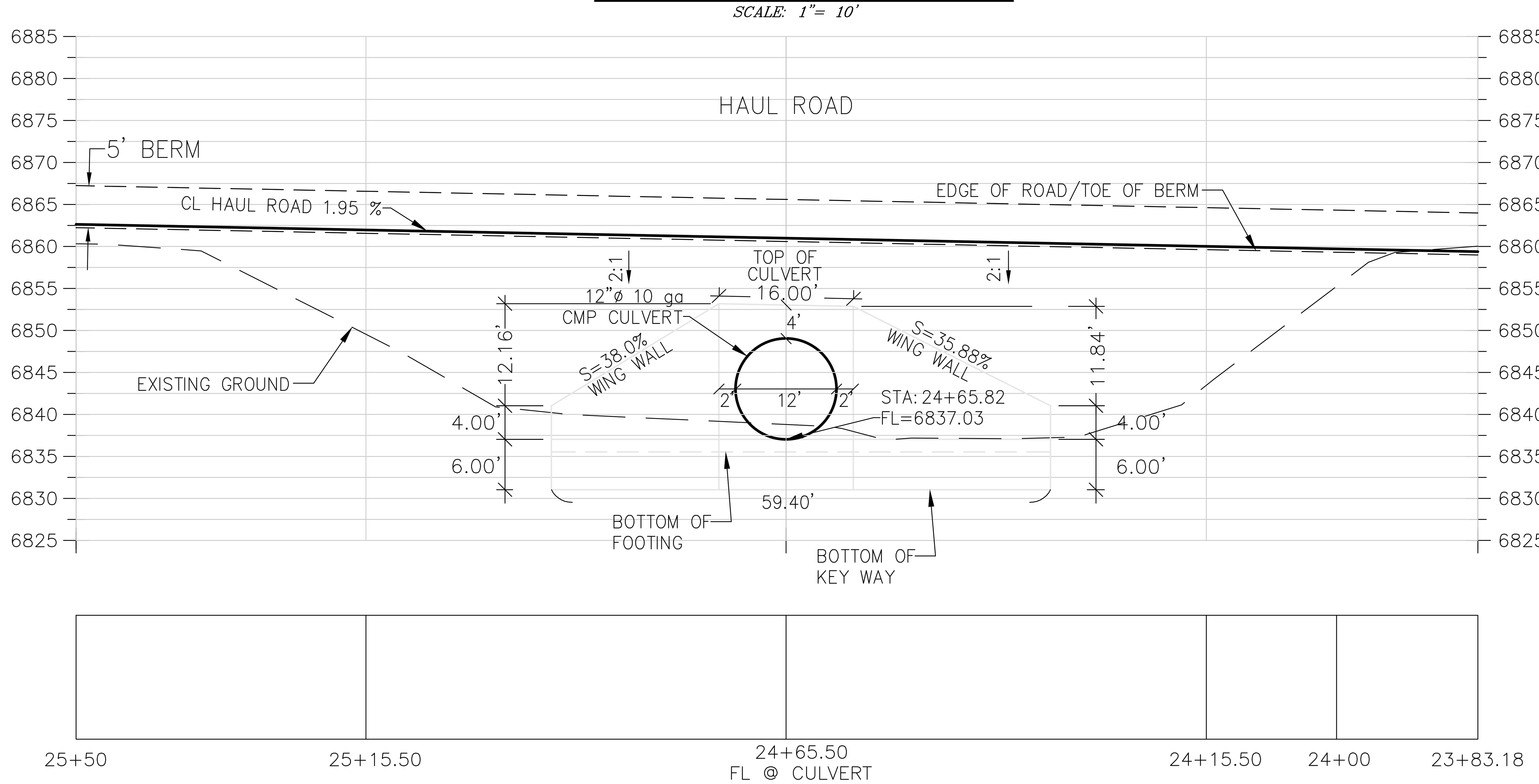


PLAN
CULVERT AND WING WALLS
SCALE: 1"= 10'



LEGEND

3075	PROPOSED MAJOR CONTOUR
	PROPOSED MINOR CONTOUR
3070	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR



ELEVATION
CULVERT AND WING WALLS
SCALE: HORZ. 1"= 10'
VERT. 1"= 10'

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REVISIONS

NO.	DESCRIPTION	DATE	BY
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

CULVERT HEADWALL PLAN & PROFILE
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT INLET
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PROFESSIONAL STRUCTURAL ENGINEER
MARC I. BROWN
06-24-16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=10'
SHEET NO. : C-P2

GENERAL

UNLESS NOTED OTHERWISE, ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE 2012 INTERNATIONAL BUILDING CODE. IT IS THE CONTRACTORS RESPONSIBILITY TO VERIFY ALL EXISTING CONDITIONS AT THE JOB SITE, AND TO FULLY COORDINATE ALL DIMENSIONS AND CONDITIONS OF DETAILS WITH OTHER DISCIPLINES. ANY FIELD CONDITIONS REQUIRING CONSTRUCTION THAT IS DIFFERENT FROM THAT SHOWN ON THE PLANS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER. ANY CONFLICTING DETAILS SHOWN IN THE DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO THE CONSTRUCTION OF SAID DETAIL. DO NOT SCALE DRAWINGS. ANY QUESTIONS REGARDING THE CONSTRUCTION DOCUMENTS SHALL BE SUBMITTED TO THE ENGINEER IN THE FORM OF A WRITTEN REQUEST FOR ALL INFORMATION.

ALL SUPPORT OF CONSTRUCTION LOADS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ALL SHORING AND BRACING REQUIRED FOR THE PROTECTION OF LIVE AND PROPERTY DURING THE CONSTRUCTION PROCESS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ALL PROCEDURES OF SOIL EXCAVATION, BACKFILL, AND SUPPORT OF ADJACENT PROPERTY DURING EARTHWORK SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.

FOUNDATIONS

MAXIMUM ALLOWABLE SOIL PRESSURE; = 2,000 PSF PER GEOTECHNICAL REPORT BY GEM ENGINEERING INC. DATED OCTOBER 14, 2015, REPORT No. RG1434

ADDENDUM 1 BY GEM ENGINEERING INC. DATED NOVEMBER 4, 2015, REPORT NO. RG1434

ALL FOOTING DEPTHS INDICATED ON PLANS ARE MINIMUM DEPTHS, FOOTINGS MAY BE PLACED IN NEAT EXCAVATED TRENCHES. TRENCH SHALL BE APPROVED BY INSPECTOR PRIOR TO PLACEMENT OF CONCRETE. AT LOCATIONS WHERE STRUCTURAL FILL IS REQUIRED, FILL SHALL BE PLACED IN 6" LIFTS AND COMPACTED AT OPTIMUM MOISTURE CONTENT. REFER TO SOILS INVESTIGATION FOR DEPTH AND EXTENT OF STRUCTURAL FILL.

CONCRETE

ALL CONCRETE MATERIALS SHALL COMPLY WITH THE STANDARDS SPECIFIED IN THE LATEST EDITION OF THE ACI 318 BUILDING CODE, EACH MIX DESIGN SHALL BE REVIEWED BY AN APPROVED INDEPENDENT LABORATORY, AND SHALL BE SUBMITTED TO THE ENGINEER AT LEAST 2 WEEKS PRIOR TO THE PLACEMENT OF CONCRETE. CONTRACTOR SHALL INFORM THE ENGINEER AT LEAST 2 DAYS PRIOR TO PLACING ANY CONCRETE SO THAT THE ENGINEER MAY HAVE THE OPPORTUNITY TO REVIEW THE WORK.

CONCRETE TESTING SHALL BE PERFORMED BY AN APPROVED INDEPENDENT TESTING LABORATORY. THE TESTING AGENCEY SHALL TEST 4 CYLINDERS FROM EACH CLASS OF CONCRETE USED EACH DAY. A MINIMUM OF (1) SAMPLE MUST BE TAKEN FROM EACH 50 CUBIC YARDS OF CONCRETE.

USE TYPE II OR TYPE V CEMENT WITH A MAX WATER TO CEMENT RATIO OF 0.50.

LOCATION	SPECIAL INSPECT.	SLUMP (MAX)	AGGREGATE (MAX SIZE)	COMPRESSIVE STRENGTH (PSI)
FOOTINGS	NO	5	1" DIA	4000(2500 WAS USED IN DESIGN)
STEM WALLS	NO	5	1' DIA	4000(2500 WAS USED IN DESIGN)
SLAB ON GRADE	NO	5	3-1/2" DIA	4000(2500 WAS USED IN DESIGN)

ANY CONCRETE THAT FAILS TO MEET SPECIFICATIONS SHALL BE REMOVED AND REPLACED AT THE EXPENSE OF THE CONTRACTOR.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION, DESIGN, PLACEMENT AND REMOVAL OF ALL FORMWORK. ALL SHORING DURING PLACEMENT OF CONCRETE IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

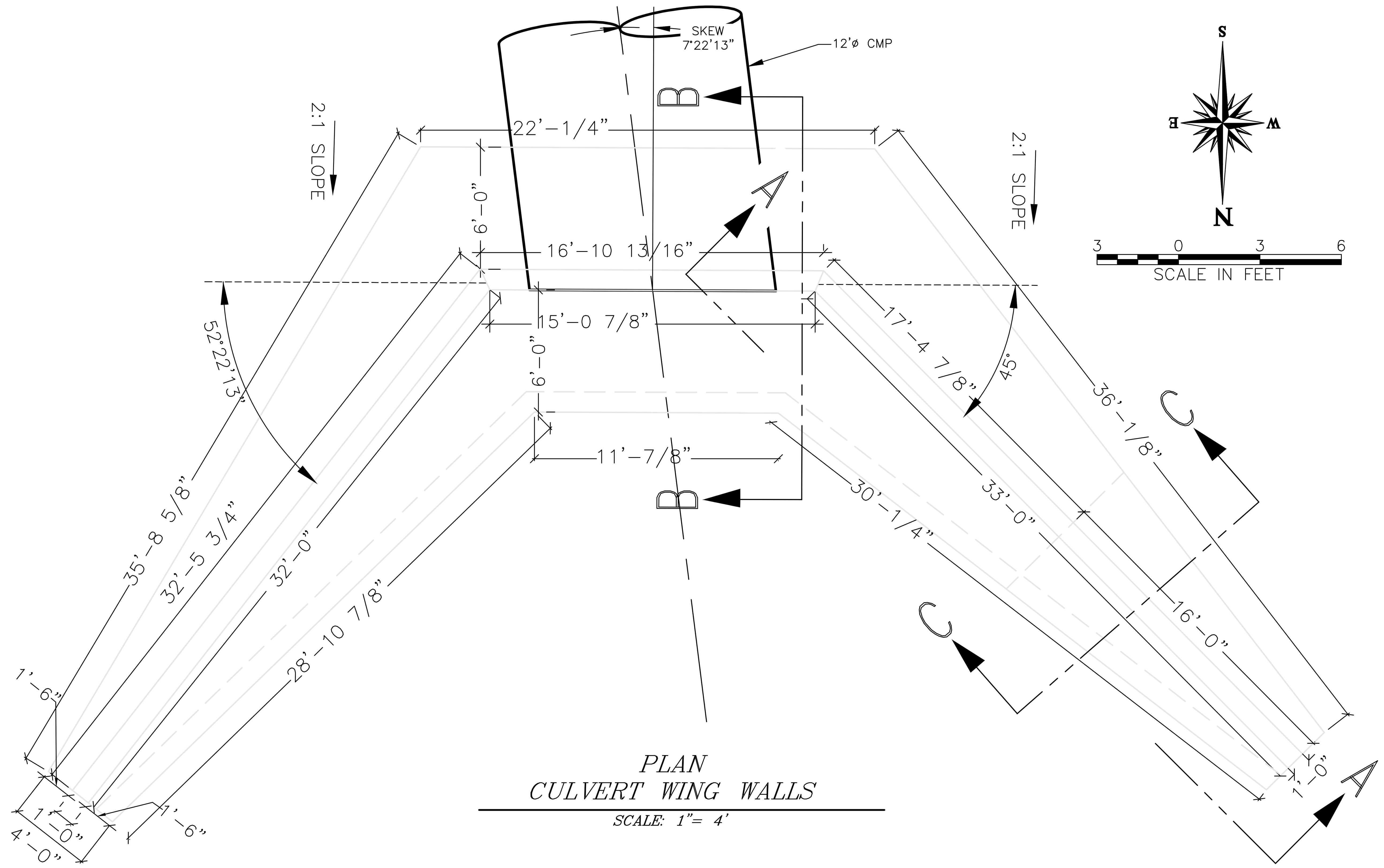
CONCRETE SHALL BE SPECIALLY INSPECTED PER IBC 2012, TABLE 1704.4

CONCRETE REINFORCING

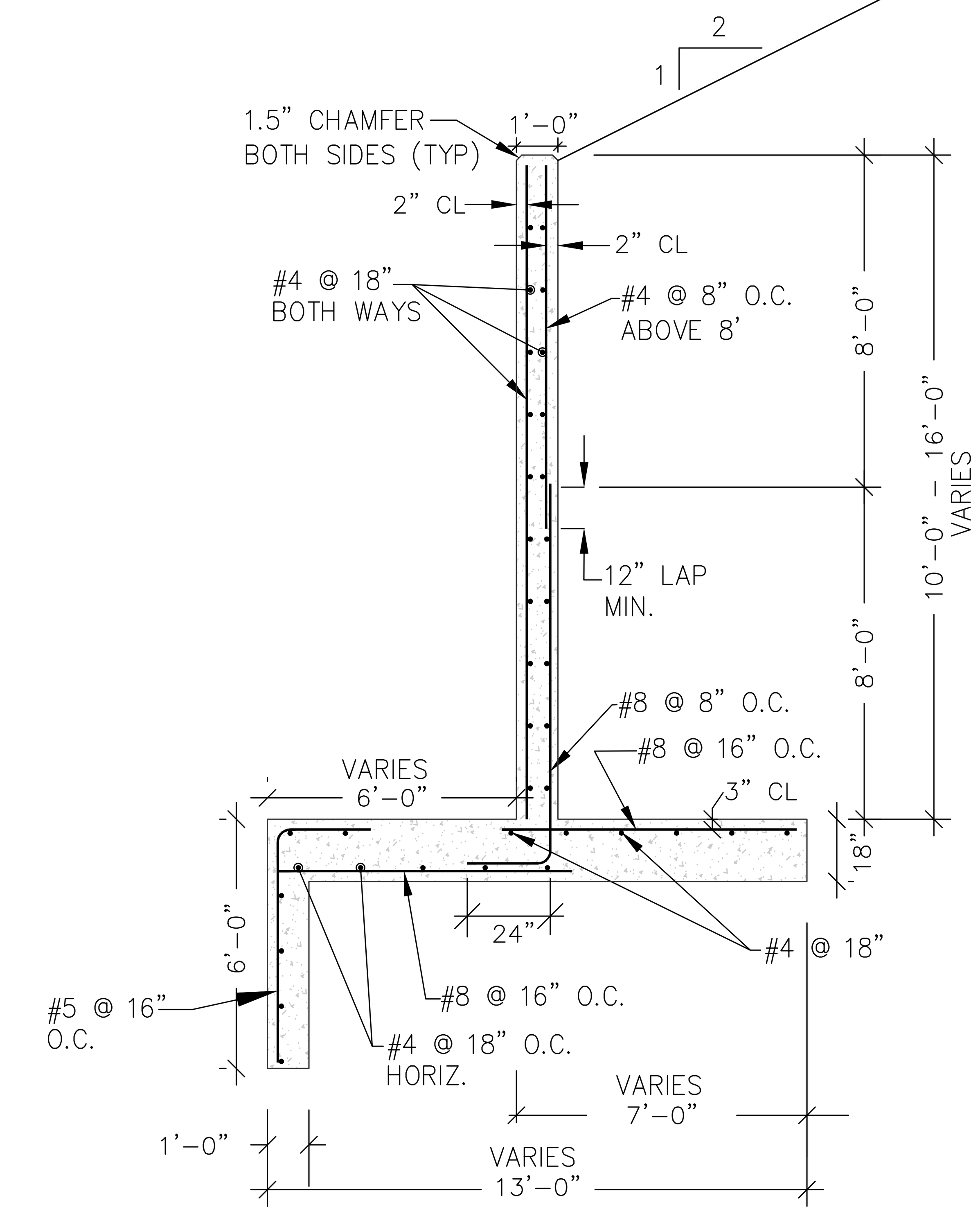
ALL REINFORCING BARS SHALL CONFORM TO ASTM A-615 GRADE 60, FY=60,000 PSI MIN., UNLESS NOTED OTHERWISE. BARS SHALL BE TIED SECURE PRIOR TO PLACEMENT OF CONCRETE TO MAINTAIN PROPER PLACEMENT AFTER CONCRETE IS IN PLACE. LAP ALL BARS 40 DIAMETERS UNLESS NOTED OTHERWISE. SPLICE BARS ONLY WHERE SHOWN ON PLANS.

MAINTAIN THE FOLLOWING CONCRETE COVERAGE FOR CONCRETE REINFORCING:

UNFORMED SURFACES IN CONTACT WITH EARTH..........3"
FORMED SURFACES IN CONTACT WITH EARTH..............2"
FORMED SURFACES EXPOSED TO OUTSIDE WEATHER...2"
SLABS AND WALLS NOT EXPOSE TO WEATHER............1-1/2"



PLAN
CULVERT WING WALLS
SCALE: 1"= 4'



SECTION B-B 10'-16' WING WALL
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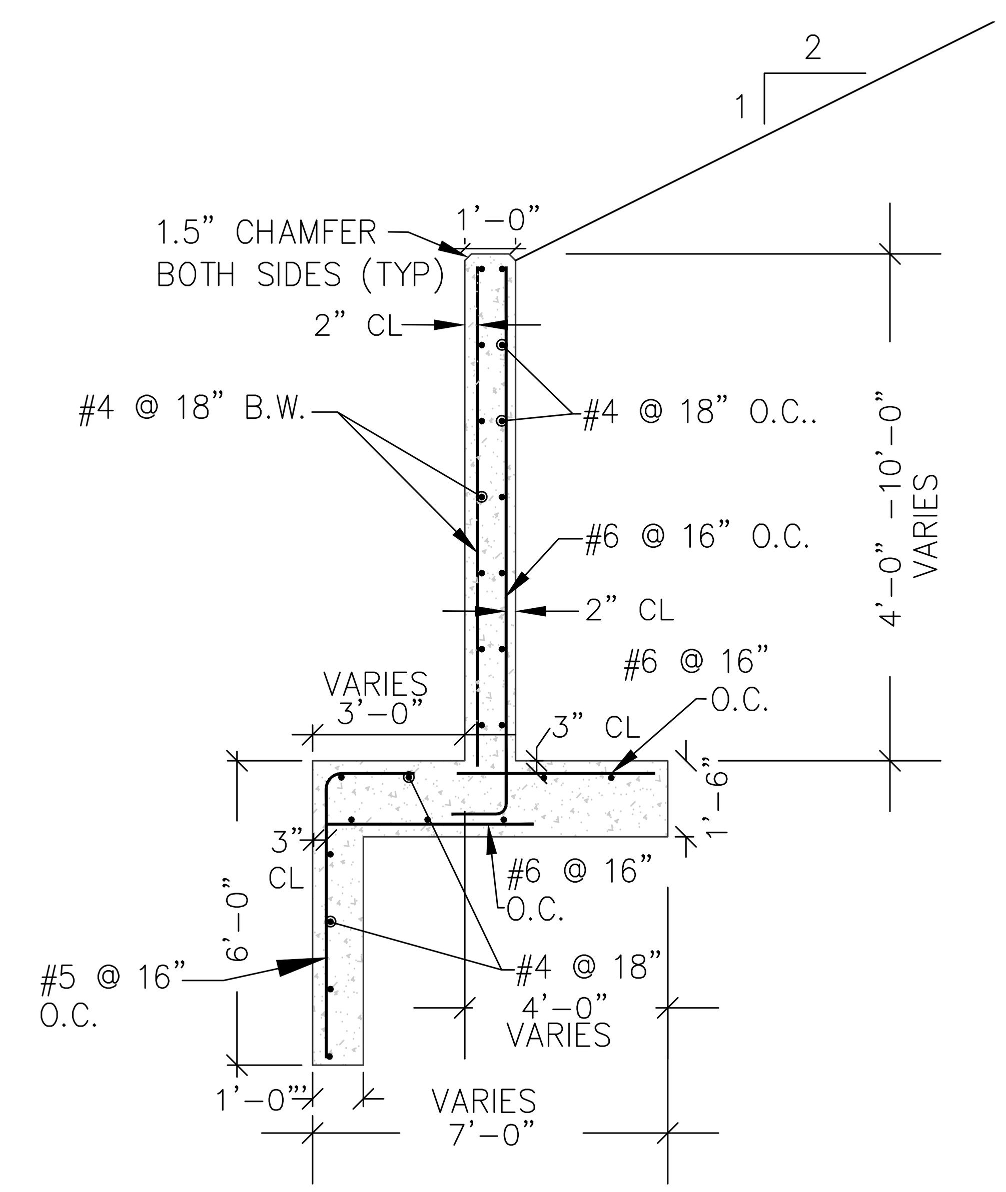
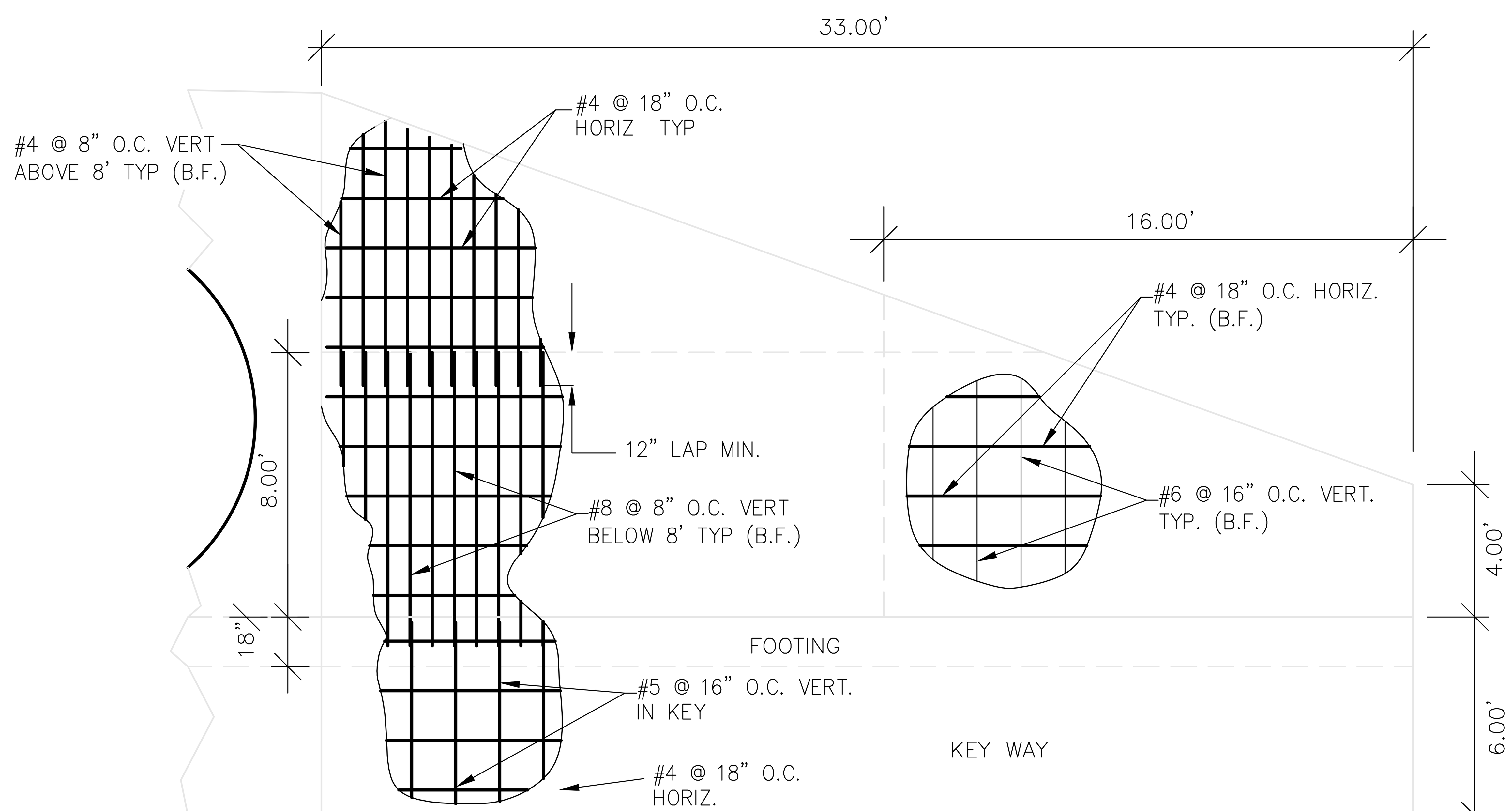


SECTION C-C 4'-10' WING WALL
SCALE: 1"=3"



ELEVATION A-A CULVERT WING WALL(TYPICAL)
SCALE: 1"=3"

AVOID CUTTING UNDERGROUND UTILITIES. IT'S COSTLY.
Call BEFORE YOU Dig
1-800-662-4111
UNDERGROUND SERVICE (USA)

NOTICE!

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NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT KANE COUNTY STANDARDS.

REVISIONS

NO.	DESCRIPTION	DATE	BY
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

HEADWALL & WING WALL DETAILS
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT INLET
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PROFESSIONAL STRUCTURAL ENGINEER
MARC L. BROWN
02-09-16
STATE OF UTAH

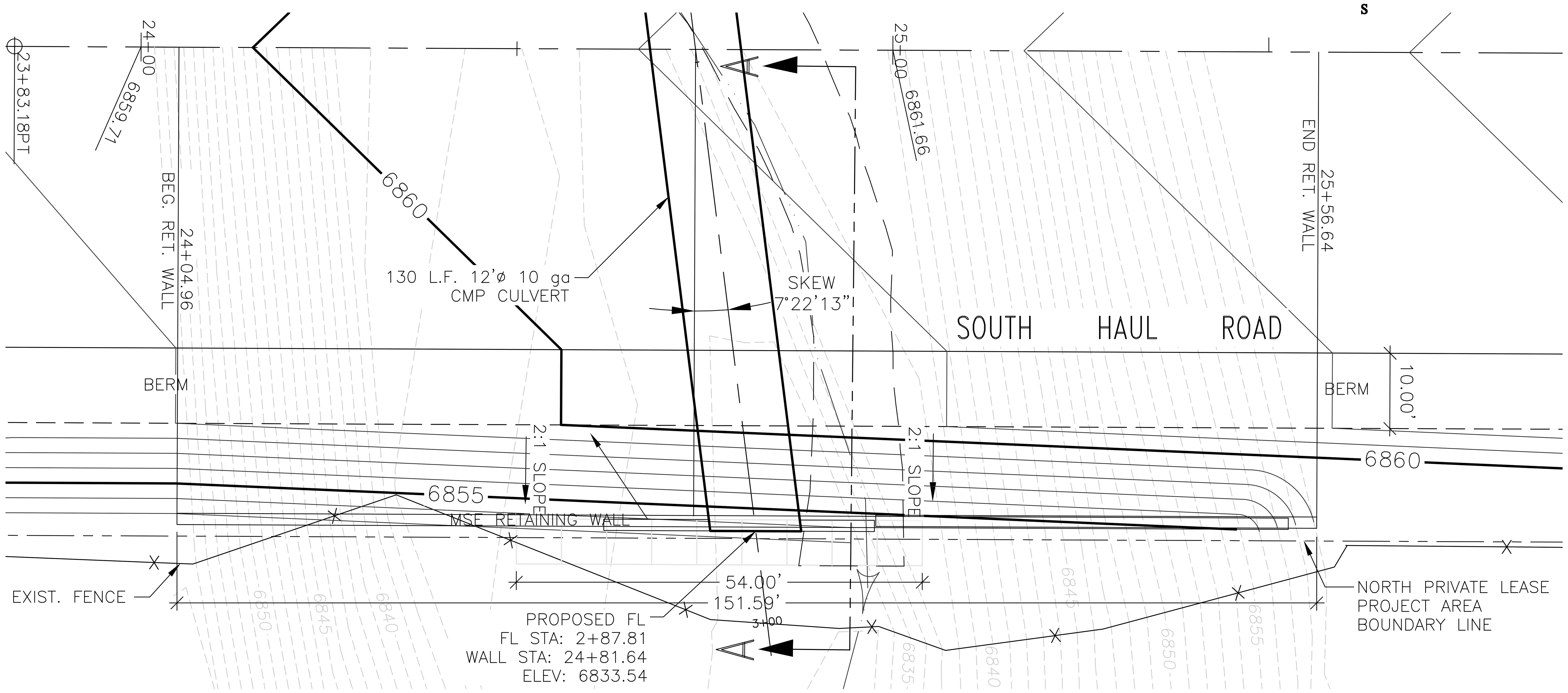
CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=3'
SHEET NO. : C-P3

LEGEND

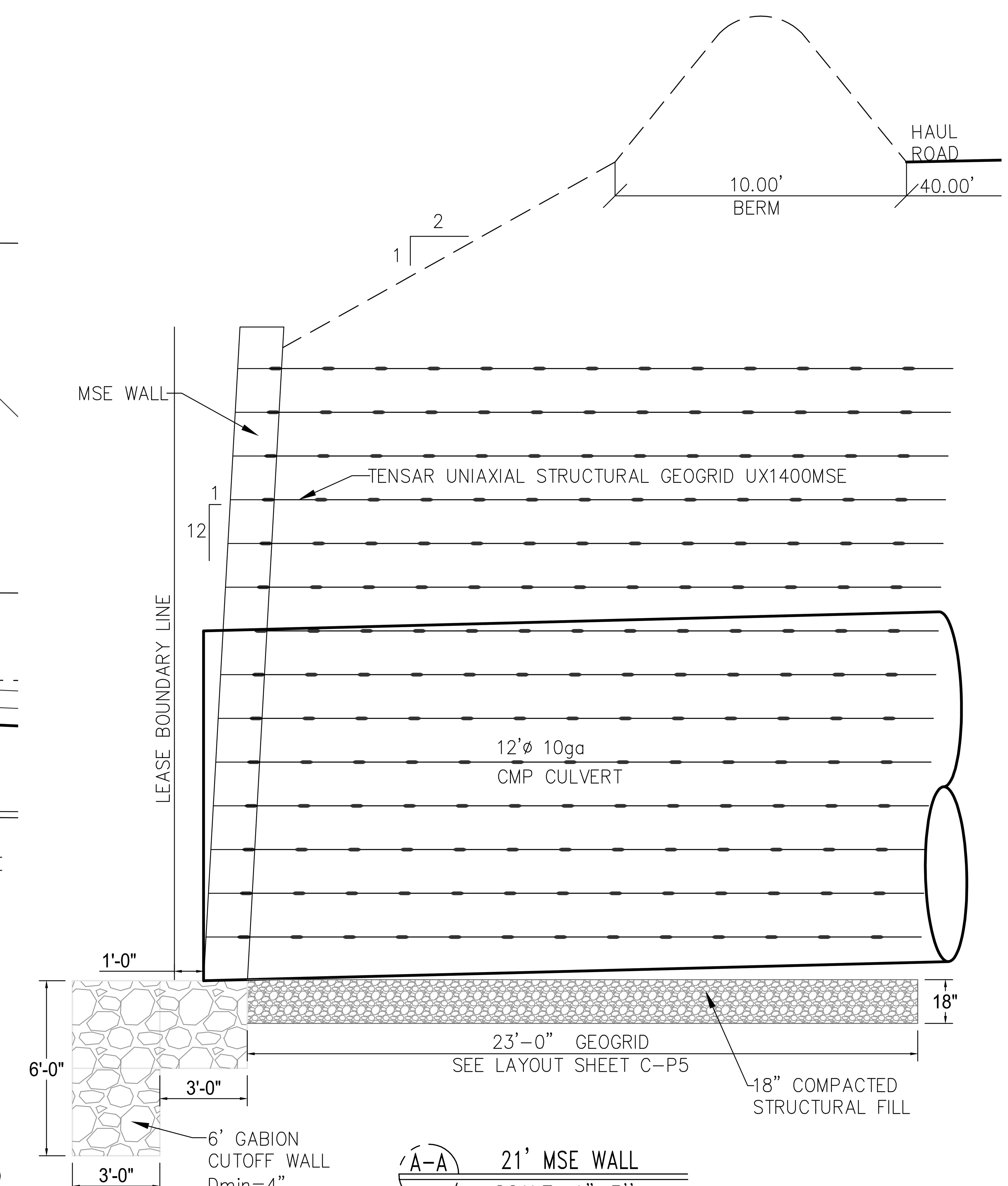
3075	PROPOSED MAJOR CONTOUR
	PROPOSED MINOR CONTOUR
3070	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR

10 0 10 20
SCALE IN FEET

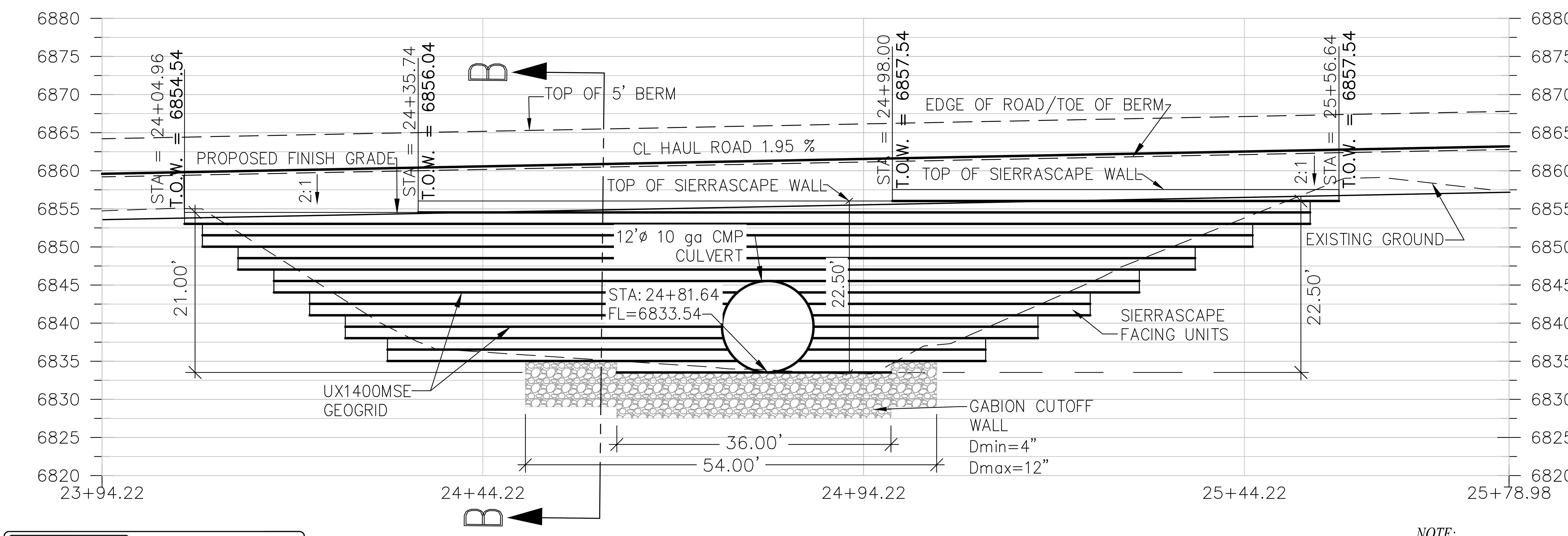
N W E S



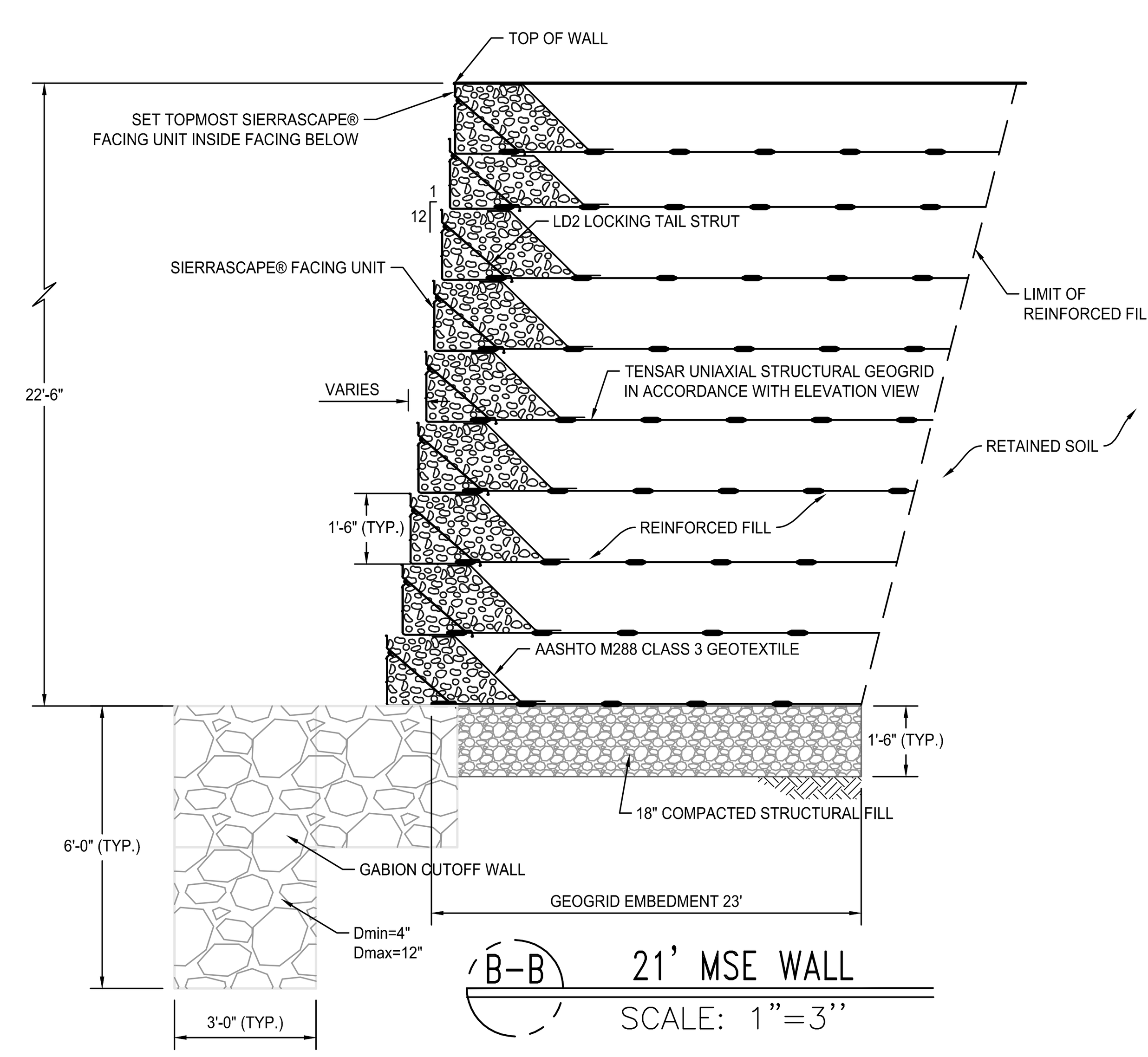
PLAN
MSE WALL
SCALE: 1"= 10'



A-A 21' MSE WALL
SCALE: 1"=3"



ELEVATION
MSE WALL
SCALE: HORZ. 1"= 10'
VERT. 1"= 10'



B-B 21' MSE WALL
SCALE: 1"=3"

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NOTICE!
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NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT KANE COUNTY STANDARDS.

NOTE:

NOTE:
THE MSE WALL SHOWN IS PRELIMINARY DESIGN FOR ESTIMATING PURPOSES ONLY. THE FINAL DESIGN AND CONSTRUCTION TO BE IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS. (TENSAR)

SOILS REPORT BY GEM ENGINEERING
FOR ALTON COAL DEVELOPMENT
DATED: OCTOBER 14, 2015
REPORT No. RG1434

REVISIONS

NO.	DESCRIPTION	DATE	BY
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

MSE RETAINING WALL
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT C-3 OUTLET
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PROFESSIONAL STRUCTURAL ENGINEER
MARC BROWN
70223
06-24-16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47

SCALE : 1"=10'

SHEET NO. : C-P4

PRODUCT SPECIFICATION-STRUCTURAL GEOGRID UX1400MSE

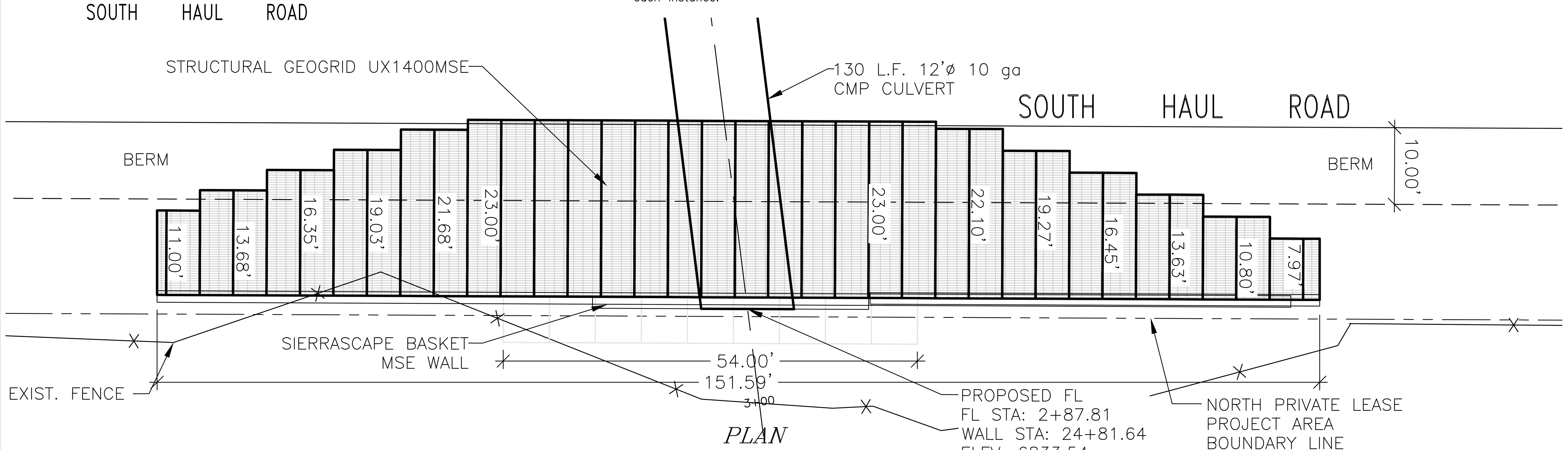
Product Specification – Structural Geogrid UX1400MSE
Product Type: Integrally Formed Structural Geogrid
Polymer: High Density Polyethylene
Load Transfer Mechanism: Positive Mechanical Interlock
Recommended Applications: MESA System (Segmental Block Walls), ARES System (Panel Walls), SierraScape System (Welded Wire Walls)

Product Properties
Index Properties Units MD Values1
Tensile Strength @ 5% Strain2 kN/m (lb/ft) 31 (2,130)
Ultimate Tensile Strength2 kN/m (lb/ft) 70 (4,800)
Junction Strength3 kN/m (lb/ft) 66 (4,520)
Flexural Stiffness4 mg–cm 730,000

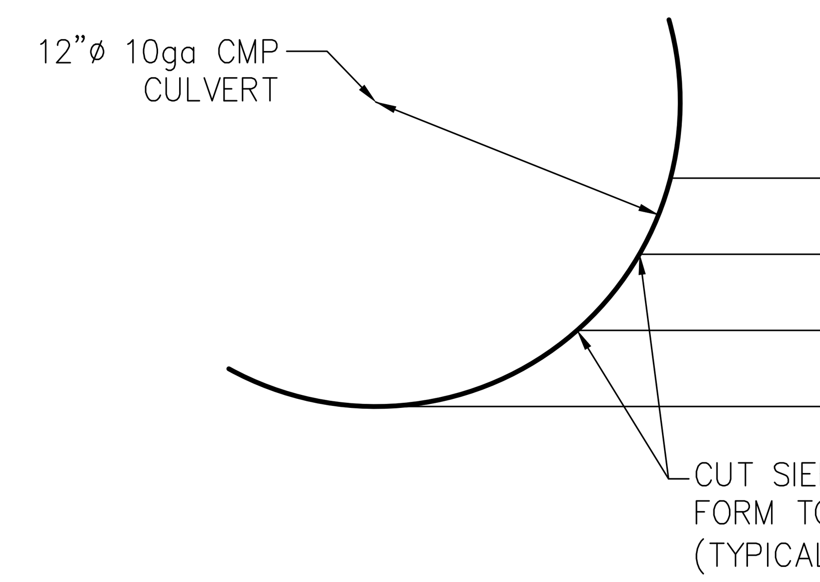
Durability
Resistance to Long Term Degradation5 % 100
Resistance to UV Degradation6 % 95

Load Capacity
Maximum Allowable (Design) Strength for 120–year Design Life7 kN/m (lb/ft)
25.6 (1,760) Recommended Allowable Strength Reduction Factors7
Minimum Reduction Factor for Installation Damage (RFID)8 1.05
Reduction Factor for Creep for 120–year Design Life (RFCR) 9 2.60
Minimum Reduction Factor for Durability (RFD) 1.00
Dimensions and Delivery
The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 1.33 meters (4.36 feet) in width and 76.2 meters (250.0 feet) in length. A typical truckload quantity is 432 rolls.

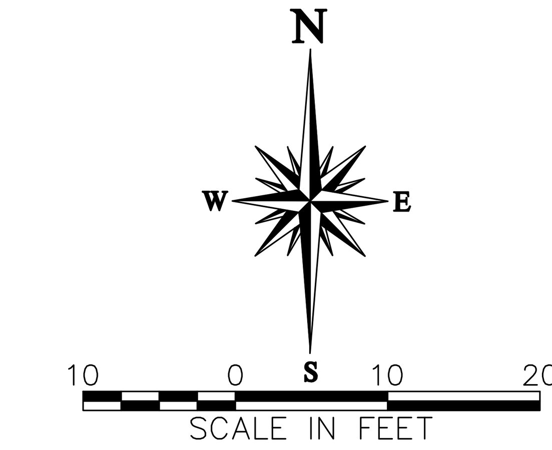
Notes:
1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759–02. Brief descriptions of test procedures are given in the following notes.
2. True resistance to elongation when initially subjected to a load measured via ASTM D6637–01 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
3. Load transfer capability determined in accordance with GRI–GG2–05.
4. Resistance to bending force determined in accordance with ASTM D5732–01, using specimen dimensions of 864 millimeters in length by one aperture in width.
5. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
6. Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355–05.
7. Reduction factors are used to calculate the geogrid strength available for resisting force in long–term load bearing applications. Allowable Strength (Tallow) is determined by reducing the ultimate tensile strength (Tult) by reduction factors for installation damage (RFID), creep (RFCR) and chemical/biological durability (RFD = RFCD RFBD) per GRI–GG4–05 [Tallow = Tult/(RFID RFCR RFD)]. Recommended minimum reduction factors are based on product–specific testing. Project specifications, standard public agency specifications and/or design code requirements may require higher reduction factors. Design of the structure in which the geogrid is used, including the selection of appropriate reduction factors and design life, is the responsibility of the outside licensed professional engineer providing the sealed drawings for the project.
8. Minimum value is based on Installation Damage Testing in Sand, Silt, and Clay soils. Coarser soils require increased RFID values.
9. Reduction Factor for Creep determined for 120–year design life and in–soil temperature of 20°C using standard extrapolation techniques to creep rupture data obtained following the test procedure in ASTM D5262–04. Actual design life of the completed structure may differ. Tensar International Corporation reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance.



PLAN
MSE WALL
SCALE: 1"= 10'



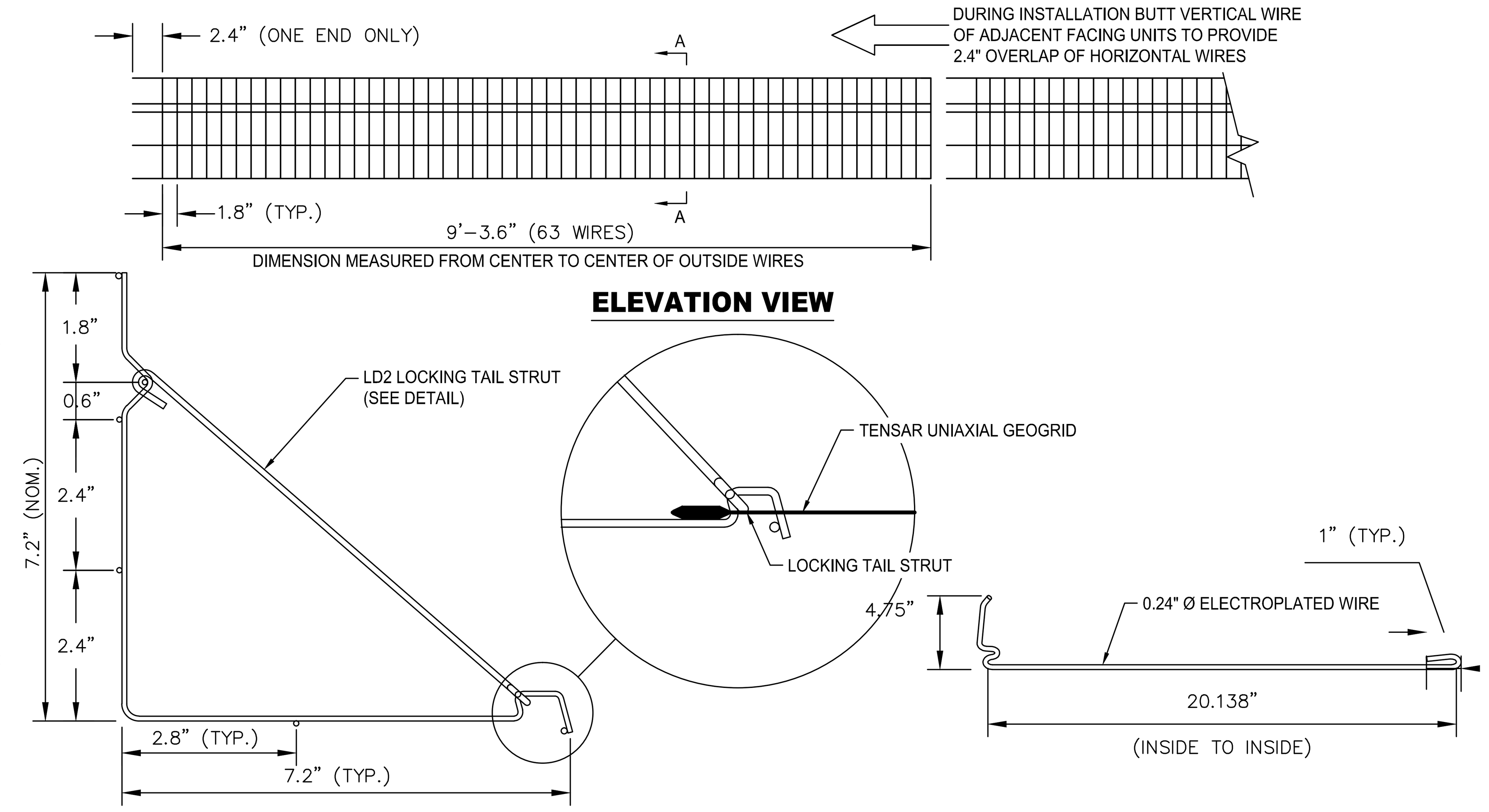
SIERRASCAPE AT PIPE DETAIL
SCALE: 1"=3"



LEGEND

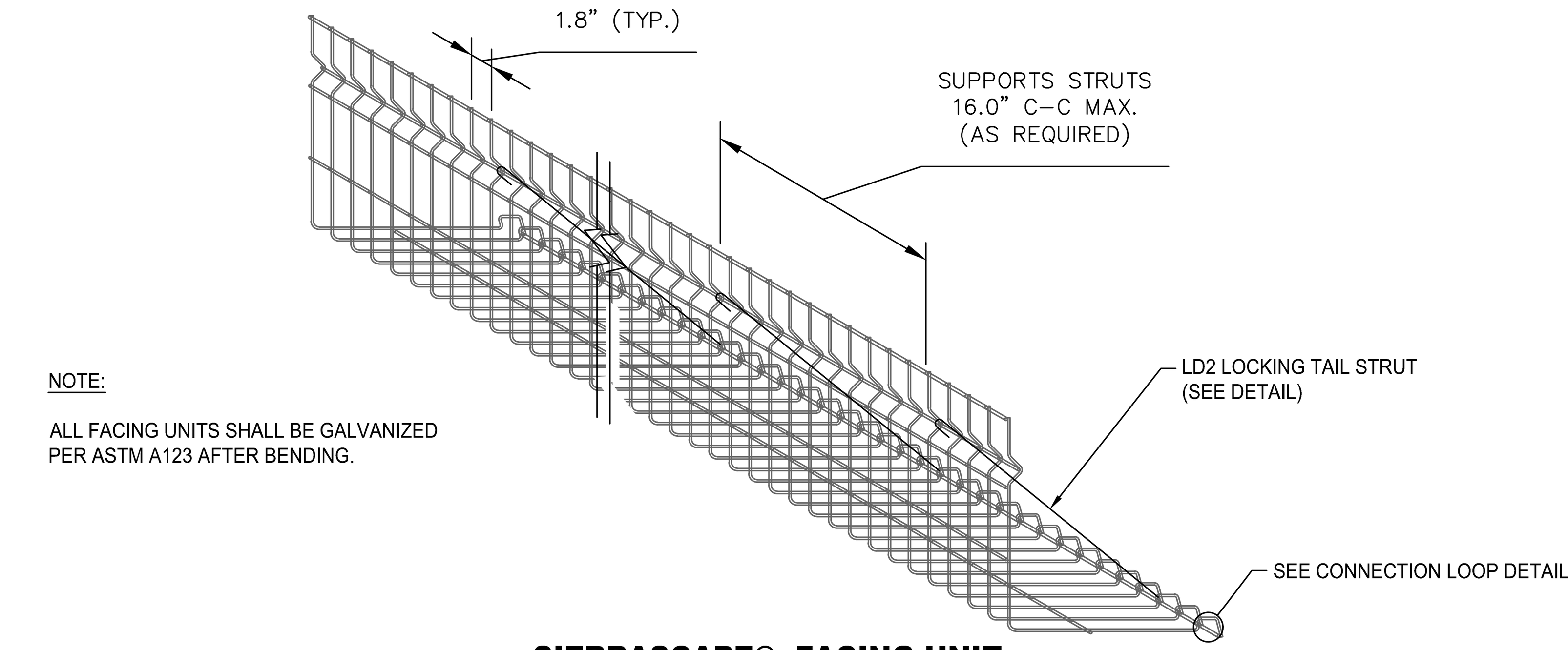
UX1400MSE GEOGRID

SIERRASCAPE FACING UNIT



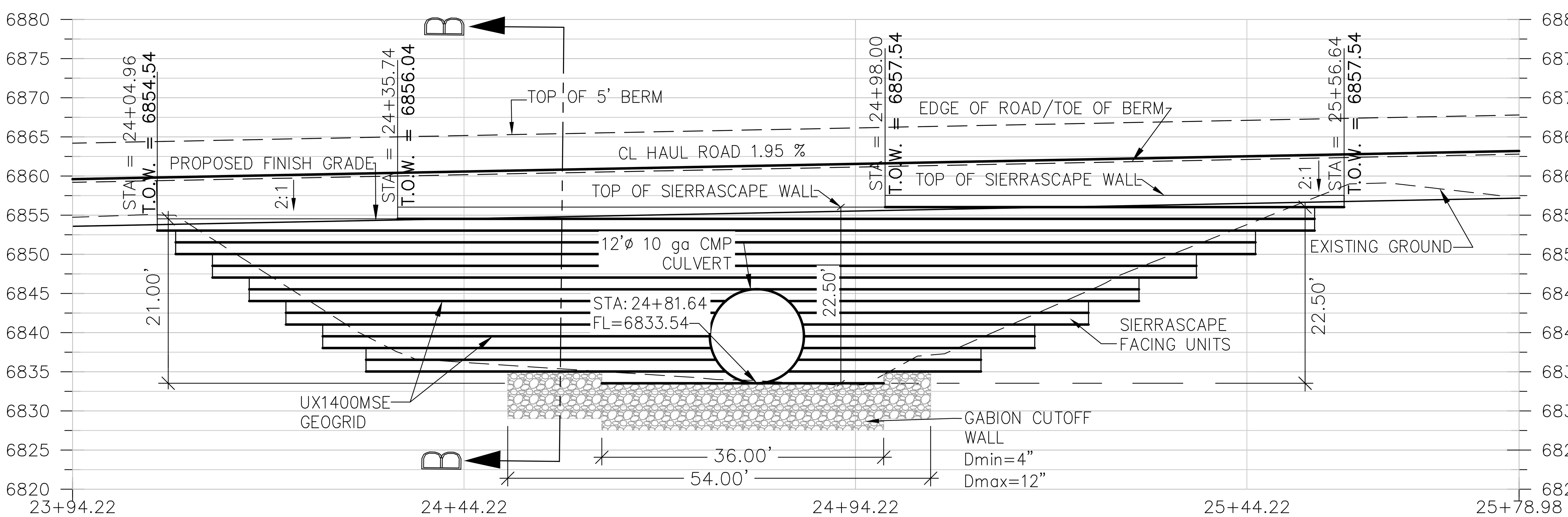
ELEVATION VIEW

SECTION A-A | **CONNECTION LOOP DETAIL** | **LD2 LOCKING TAIL STRUT DETAIL**



NOTE:
ALL FACING UNITS SHALL BE GALVANIZED PER ASTM A123 AFTER BENDING.

SIERRASCAPE® FACING UNIT
NOT TO SCALE



ELEVATION
MSE WALL
SCALE: HORZ. 1"= 10'
VERT. 1"= 10'

NOTE:
THE MSE WALL SHOWN IS PRELIMINARY DESIGN FOR ESTIMATING PURPOSES ONLY. THE FINAL DESIGN AND CONSTRUCTION TO BE IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS. (TENSAR)

SOILS REPORT BY GEM ENGINEERING
FOR ALTON COAL DEVELOPMENT
DATED: OCTOBER 14, 2015
REPORT No. RG1434

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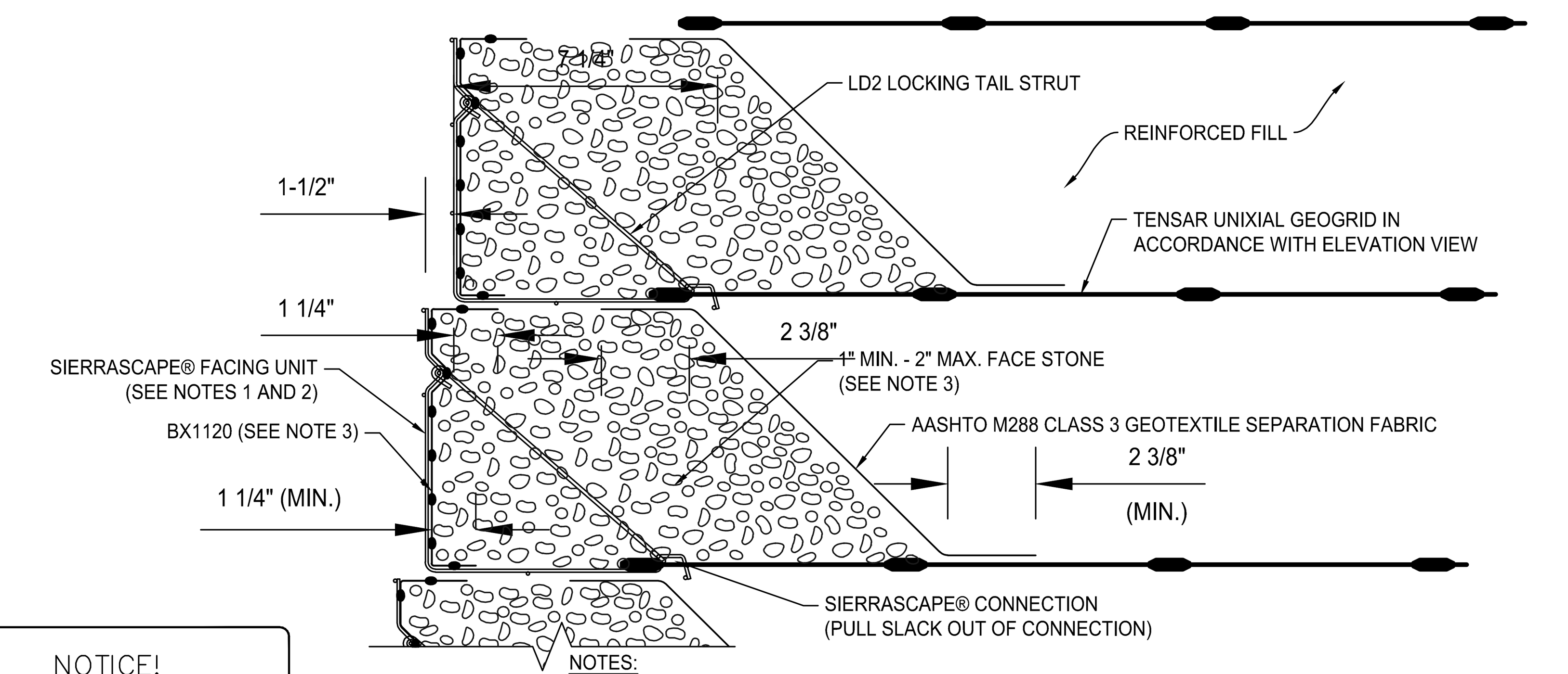

NOTES:
1. SEE SIERRASCAPE® FACING UNIT DETAIL FOR FACING MATERIAL AND DIMENSIONS.
2. ALL FACING UNITS SHALL BE GALVANIZED PER ASTM A123 AFTER FABRICATION.
3. TENSAR BX1120 FACE BACKING (24" MINIMUM WIDTH) IS REQUIRED FOR AASHTO M43 No. 3 FACE STONE (1" TO 2"). BX1120 FACE BACKING IS NOT REQUIRED FOR STANDARD FACE STONE FILL (2" TO 4").
4. AASHTO M288 CLASS 3 GEOTEXTILE SEPARATION FABRIC MAY BE OMITTED IF REINFORCED FILL SI SAME AS FACING FILL.

SIERRASCAPE® FACING DETAIL
(1"-2" STONE FACE FILL)
NOT TO SCALE

REVISIONS

NO.	DESCRIPTION	DATE	BY
3	CHANGED C–2 TO C–3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
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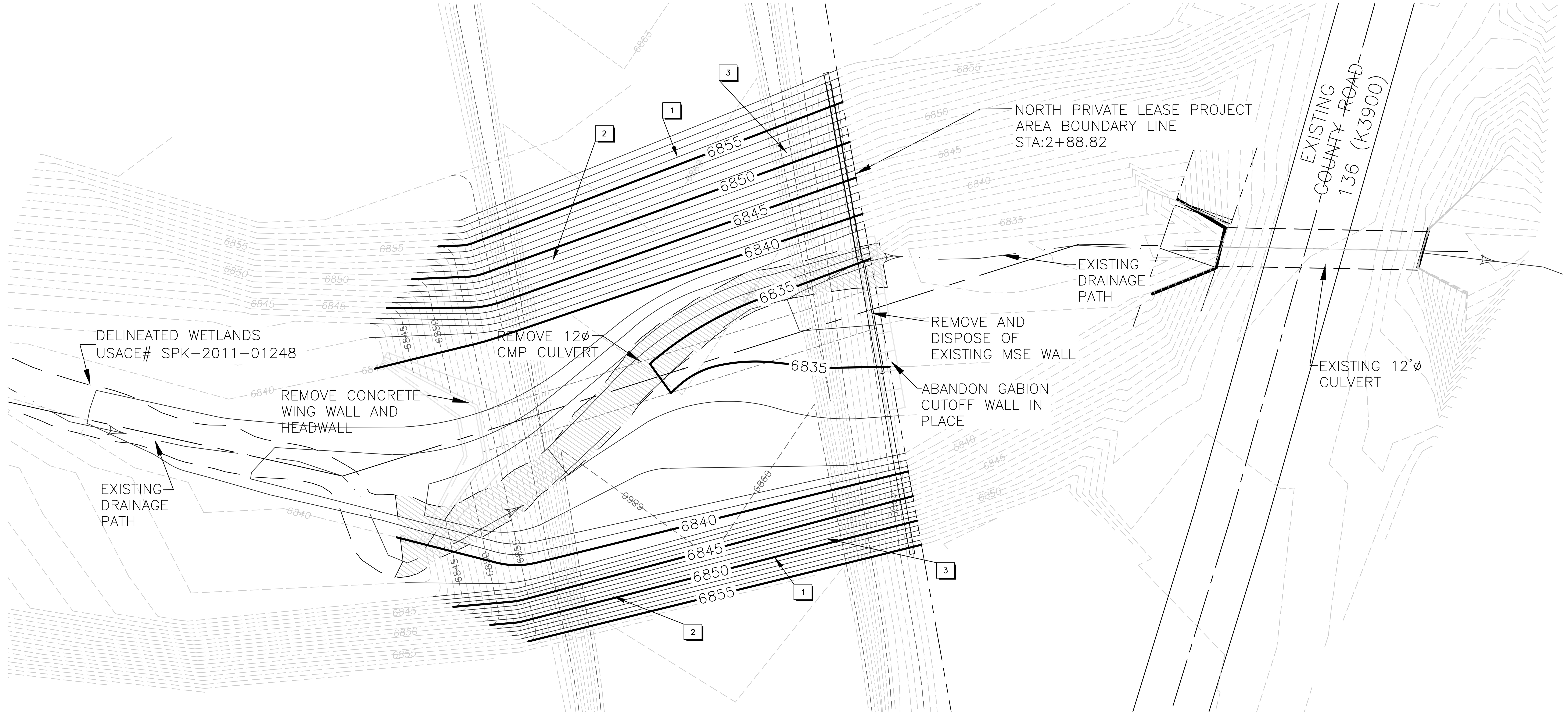
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628–4700 FAX (435) 628–4725

SIRRASCAPE MSE WALL DETAILS
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT C–3 OUTLET
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

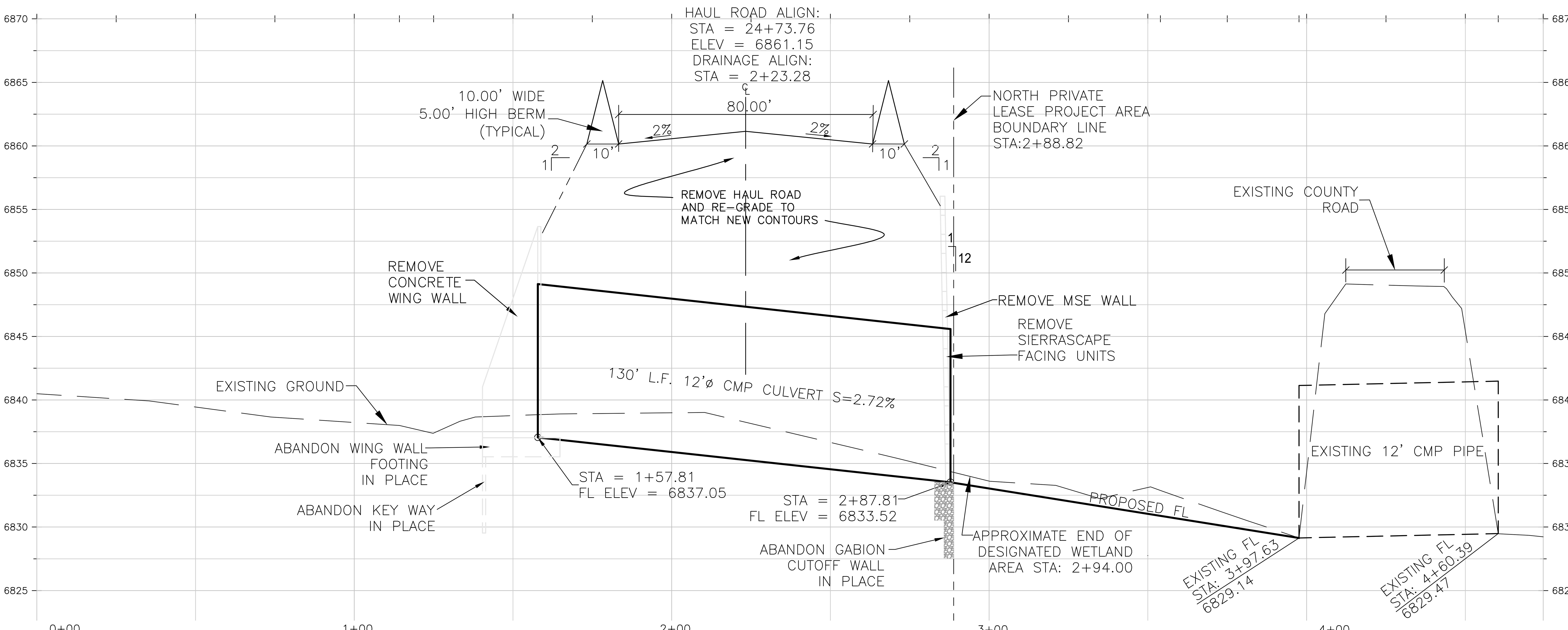
PROFESSIONAL STRUCTURAL ENGINEER
MARC L. BROWN
170223
06–24–16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=10'
SHEET NO. : C–P5



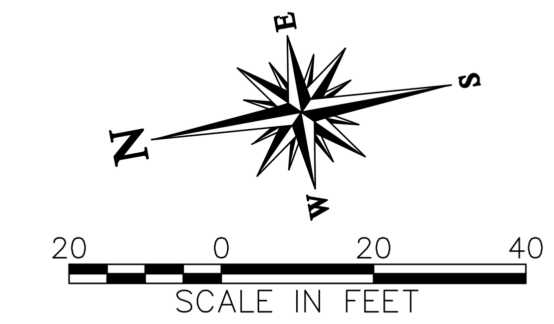
PLAN

SCALE: 1"= 20'



PROFILE

SCALE: HORZ. 1"= 20'
VERT. 1"= 5'



LEGEND

3075	PROPOSED MAJOR CONTOUR
	PROPOSED MINOR CONTOUR
3070	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR

NOTES

1. RE-GRADE TO LINES SHOWN.
2. SPREAD 4"-6" OF STOCKPILED TOPSOIL.
3. RE-SEED WITH APPROVED MIX.

AREA TO BE RE-SEEDED SHALL BE GRADED TO THE LINES AS SHOWN AND AS DIRECTED IN THE FIELD. 4"-6" OF STOCKPILED TOPSOIL SHALL THEN BE SPREAD OVER GRADED AREAS.

THE SEED SHALL BE FROM UTAH SEED COMPANY OR OTHER APPROVED SOURCE AND SHALL BE DRILLED AT THE RATE OF 12 lb/AC.

SEED MIX SHALL BE:

INDIAN RICE GRASS	2.0 lb
SIBERIAN WHEAT GRASS	3.6 lb
INTERMEDIATE WHEAT GRASS	3.2 lb
FOUR-WING SALT GRASS	2.2 lb
ALFALFA	1.0 lb
TOTAL	12.0 lb/ACRE (DRILLED SEED RATE)

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UNDERGROUND SERVICE (USA)

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REVISIONS

NO.	DESCRIPTION	DATE	BY
2	ADDED MITIGATION PLAN	2/16/16	SWB
3	CHANGED C-2 TO C-3	6/24/16	SWB

BCE
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

RESTORATION/MITIGATION PLAN
FOR
SOUTH HAUL ROAD
KANAB CREEK CULVERT C-3
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PROFESSIONAL STRUCTURAL ENGINEER
MARC L. BROWN
170223
06-24-16
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : JANUARY 2016
JOB NO. : 15-47
SCALE : 1"=20'
SHEET NO. : C-P6

TABLE OF CONTENTS

Chapter 7

R645-301-300

HYDROLOGY

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Appendix 7-12	UPEDS Permit No. UTG040027
Appendix 7-13	Petersen Hydrologic, LLC hydrologic investigation to evaluate the acid/neutralization behavior of groundwater in the coal seam
Appendix 7-14	PHC of Coal Mining in the 85.88-acre New Dame Lease IBC at Alton Coal Development, LLC Coal Hollow Mine
Appendix 7-15	Probable Hydrologic Consequence of Underground Coal Mining at the Alton Coal Development, LLC Coal Hollow Mine
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Appendix 7-18	Characterization of Alluvial Groundwater Systems in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

CHAPTER 7

R645-301-700. HYDROLOGY

711. GENERAL REQUIREMENTS

711.100 – 711.500 Contents

This chapter provides a description of the hydrology and hydrogeology of the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area and the proposed North Private Lease area). Specifically, this permit section includes descriptions of existing hydrologic resources according to R645-301-720, proposed operations and potential impacts to the hydrologic balance according to R645-301-730, methods and calculations utilized to achieve compliance with the hydrologic design criteria and plans according to R645-301-740, applicable hydrologic performance standards according to R645-301-750, and reclamation activities according to R645-301-760.

This information is presented in subsequent sections of this chapter and in Appendix 7-1. Appendix 7-1 includes a comprehensive characterization of groundwater and surface-water systems in the Coal Hollow permit and adjacent areas (including the 85.88-acre Dame Lease IBC), recommendations for groundwater and surface-water monitoring, and the results of a field investigation regarding the potential for alluvial valley floors in the Coal Hollow Mine permit and adjacent area. It should be noted that Appendix 7-1 may be updated periodically in the future as additional hydrologic and hydrogeologic data become available. A characterization of groundwater and surface-water systems in the proposed North Private Lease area is presented in Appendix 7-16 (Petersen Hydrologic, 2015). Appendix 7-16 also includes recommendations for groundwater and surface-water monitoring in the proposed North Private Lease area. Appendix 7-18 provides further characterization of alluvial groundwater systems in the North Private Lease area.

712 CERTIFICATION

All cross sections, maps, and plans have been prepared per R645-301-512. Compliance with this section has been completed and certifications are available on all Drawings. The cross sections and maps that are included in this permit application and are required to be certified have been prepared by or under the direction of a qualified, registered, professional engineer or a professional geologist, with assistance from experts in related fields such as hydrology, geology and landscape architecture.

713 INSPECTION

Impoundments will be inspected as described under R645-301-514.300. Designs for proposed impoundments in the Coal Hollow permit area are shown in Drawings 5-25 through 5-31 and Appendices A5-1 and A5-2.+ Designs for proposed impoundments in the Coal Hollow permit area are shown in Drawings 5-67 through 5-71. No impoundments or sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) exist or are planned within the Coal Hollow Mine permit area including the proposed North Private Lease area.

A professional engineer or specialist experienced in the construction of impoundments will inspect impoundments. Inspections will be made regularly during construction, upon completion of construction, and at least yearly until removal of the structure or release of the performance bond. The qualified registered professional engineer will promptly, after each inspection, provide to the Division, a certified report that the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 Rules. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded waters, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability. A copy of the report will be retained at or near the mine site.

720 ENVIRONMENTAL DESCRIPTION

721 GENERAL REQUIREMENTS

The existing, pre-mining hydrologic resources within the permit and adjacent areas that may be affected by coal mining and reclamation operations (including the 85.88-acre Dame Lease IBC and the proposed new North Private Lease area) are described in Appendix 7-1 and Appendix 7-16 and are summarized below.

<u>Groundwater Resources</u>

A spring and seep survey of the Coal Hollow Mine permit and surrounding area (that includes the 85.88-acre Dame Lease IBC) has been conducted by Petersen Hydrologic, LLC (see sub-appendix B of Appendix 7-1). The locations of springs and seeps in the permit and adjacent area are shown on Drawing 7-1. The results of a spring and seep survey conducted by Petersen Hydrologic in the new North Private Lease area are presented in Appendix 7-16. Seasonal discharge and field water quality measurements for springs and seeps in the Coal Hollow Mine permit and adjacent area have been submitted electronically to the Utah Division of Oil, Gas and Mining Utah Coal Mining

Water Quality Database (UDOGM, 2007). Baseline discharge and water quality data for groundwater resources in the Coal Hollow Mine permit and adjacent area are have also been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007). Locations of baseline monitoring stations are shown on Drawing 7-2. Locations of water rights in and adjacent to the Coal Hollow Mine permit area (including the 85.88-acre Dame Lease IBC area) are shown on Drawing 7-3. Locations of water rights in the North Private Lease and adjacent area are shown on Drawing 7-3N. Water rights data from the Coal Hollow Mine permit and adjacent area are detailed in Appendix 7-3. Water rights data from the proposed North Private Lease and adjacent area are shown in Appendix 7-3N. A plot showing potentiometric levels in alluvial groundwater systems in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) is presented in Drawing 7-13. Potentiometric levels and the direction of shallow groundwater flow in the alluvial groundwater systems in the proposed North Private Lease area are presented in Appendix 7-16 and Appendix 7-18.

There are no domestic water supply springs or wells in the mine disturbance area. However, springs that provide water for domestic and livestock use are located on and adjacent to the permit area (See Drawing 7-2 and Appendix 7-3). Spring SP-23 (Spring House Spring) is located on the eastern boundary of the Coal Hollow Mine permit area. Spring SP-23 is a groundwater seepage area with both discrete and diffuse flow with a total discharge that is usually about one gallon per minute or less. Historically, this seepage area was used as a domestic water source for the Pugh property (personal communication, Burton Pugh, 2008). However, water from SP-23, which is not developed, has not been used for this purpose for many years.

Spring SP-35 is located along the eastern boundary of the Coal Hollow Mine permit area. Discharge from SP-35 averages less than 0.25 gallons per minute and is occasionally used for drinking water during camping trips or visits to the Pugh property (personal communication, Burton Pugh, 2008). However, there is apparently no associated domestic water right associated with this spring.

Two additional springs, which are located more distant from the proposed mining areas are also used for domestic water supply sources. These include SP-40, which is located at the Sorensen property, and SP-33, which is located at the Johnson property. Springs with stockwatering rights are listed in Appendix 7-3.

As described in Appendix 7-16, only one spring has been identified within the proposed North Private Lease permit area. This spring (Coyote Seep) discharges from the alluvial groundwater system at less than one gallon per minute. There is no water right associated with this spring. There are no Utah state appropriated groundwater rights within the North Private Lease area.

Some lands east of and adjacent to the Coal Hollow Mine permit area have historically been irrigated using water from alluvial springs. However, irrigation from these springs was apparently limited to home gardens and a few fruit trees. No irrigation of these lands (other than some yard watering at the Swapp Ranch house) is currently occurring nor has it occurred in at least the past 10 years (Personal communication, Burton Pugh, 2008; Richard Dames, 2007). Additionally, limited irrigation of lands occurs east of the Coal Hollow permit area using surface waters derived from runoff from the adjacent Paunsaugunt Plateau area. Irrigation of these lands is largely limited to years with appreciable precipitation and stream runoff (Personal communication, Darlynn Sorensen, 2008).

Groundwater discharge occurs from springs and seeps in the upland areas of the Paunsaugunt Plateau east of the permit area (Tilton, 2001; Appendix 6-3). However, these springs discharge from rock strata that are topographically and stratigraphically up-gradient of and considerable distances from the Coal Hollow Mine permit area and the North Private Lease area. Consequently, groundwater systems in these areas will not be impacted by mining activities and these are not considered further here.

Groundwater resources in the Tropic Shale and underlying Dakota Formation in the permit and adjacent area and the North Private Lease area are not appreciable. During drilling activities in the Coal Hollow Mine permit and adjacent area, appreciable groundwater inflows were not encountered in the Tropic Shale. Other than a single seep (SP-37; Drawing 7-1) which discharges at a rate of less than 0.05 gpm from an apparent fracture system in a sandy horizon along the eastern margin of lower Sink Valley, no springs or seeps with measurable discharge have been identified in the Tropic Shale. The lack of appreciable groundwater discharge in the Tropic Shale is a result of the poor water transmitting properties of the marine shale unit. While sandstone units occur stratigraphically higher in the Tropic Shale in the surrounding area, in areas proposed for surface mining, the unit present consists of a fairly uniform sequence of soft shale, silty shale, and claystone with minor siltstone horizons. Competent sandstone strata in the Tropic Shale overlying proposed mining areas were not observed during drilling. The Tropic Shale acts as a barrier impeding downward migration of groundwater in the Coal Hollow Mine permit and adjacent area where it is present. The unit also forms a basal confining layer for alluvial groundwater systems in the permit area. Similar hydrogeologic properties in the Tropic Shale were noted during drilling activities in the proposed North Private Lease area.

Groundwater discharge from the Dakota Sandstone in the permit and adjacent area is also meager. The Dakota Formation consists 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. While no springs discharge from the Dakota Formation in the permit area, a spring with a discharge of about 1 gpm and displaying little seasonal variability in discharge (SP-4; Drawing 7-1) discharges from an apparent fault zone in the Dakota Formation approximately 1.1 miles south of the existing Coal Hollow permit area. Additionally, two seeps with discharges of less than 0.05 gpm (SP-27 and SP-34; Drawing 7-1) seep from the Dakota Formation in lower Sink Valley more than ½ mile south of the Coal Hollow Mine permit area. The results of slug testing performed on wells screened in the Smirl coal seam indicate relatively low values of hydraulic conductivity for the coal seam (Table 7-8). In much of the mining area, the coal seam is dry (UDOGM, 2007). Thus, appreciable migration of groundwater through the Smirl coal seam is not anticipated.

In the proposed North Private Lease area, there are no springs or seeps discharging from the Dakota Formation (Appendix 7-16). The lack of springs in the Dakota Formation is likely attributable to 1) the presence of Tropic Shale bedrock overlying the formation, which limits the potential for vertical recharge to the formation, 2) the limited surface exposure of the formation, and 3) the overall poor water transmitting potential of the Dakota Formation (Appendix 7-1).

It should be noted that there are springs that discharge below irrigated fields near the town of Alton, Utah west of the proposed North Private Lease mining areas (Appendix 7-16). These springs, which are isolated from the proposed mining areas by upland areas of low-permeability Tropic Shale bedrock, discharge at locations that are stratigraphically near the Tropic Shale/Dakota Formation contact. The bedrock in these areas has apparently been altered as a result of near-surface burning of the Smirl coal seam, which can alter the water bearing and water transmitting characteristics of the bedrock relative to the unaltered bedrock petrology. Appreciable faulting associated with the Sevier Fault Zone has also been mapped in the area to the west of the spring discharge locations (Tilton, 2001).

No water wells are known to exist in the Tropic Shale or Dakota Formation in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area, and the proposed North Private Lease area), demonstrating the inability of these formations to transmit useful quantities of water to wells. Groundwaters from the Tropic Shale and Dakota Formation do not contribute measurable baseflow to streams in the Coal Hollow Mine permit and adjacent area and the North Private Lease area (at least at the surface in stream channels).

Groundwater discharging from springs below the town of Alton, Utah do contribute to the baseflow discharge in the Simpson Hollow tributary to Kanab Creek (Appendix 7-16) west of the proposed North Private Lease area.

Natural groundwater discharge in the existing Coal Hollow Mine permit and adjacent area occurs primarily from alluvial sediments. Alluvial discharge occurs both as discrete springs and seeps (Drawing 7-1) and also locally as diffuse seepage to the surface. Groundwater discharge areas in the Coal Hollow Mine permit and adjacent area are shown on Drawing 7-4 (see also photograph section). The area of most appreciable alluvial groundwater discharge occurs in central Sink Valley in the northwest quarter of Section 29, T39S, R5W (see Drawing 7-4; groundwater discharge area A). The alluvial groundwater system in this area exists under artesian conditions, resulting from the presence of a considerable thickness of sloping, low permeability clayey sediments overlying coarser, water-bearing alluvial sediments at depth (See Drawing 6-3). The artesian alluvial groundwater system in Sink Valley is likely recharged via mountain-front-recharge along the flanks of the Paunsaugunt Plateau to the east and north of the Coal Hollow Mine permit area. This artesian alluvial groundwater system that exists along the eastern margins of Sink Valley is likely continuous from near mountain-front recharge areas southward along the eastern margins of Sink Valley to the lower portion of Sink Valley. Discharge from the alluvial groundwater systems in and adjacent to the Coal Hollow Mine permit area occurs primarily in two areas (Drawing 7-4). In the northwest quarter of Section 29, T39S, R5W, considerable natural discharge from the alluvial groundwater system occurs through springs and seeps (Drawing 7-4; groundwater discharge area A). Minor discharge from several flowing artesian wells also occurs in this area. The artesian alluvial groundwater system in eastern Sink Valley also likely provides recharge to the clayey alluvial sediments in the southwestern portion of the valley in the Coal Hollow Mine permit area. Discharge from the alluvial groundwater system in groundwater discharge area A area results in decreases to the amount of water in storage in the alluvial groundwater system and also decreases in artesian hydraulic pressure in the aquifer.

Appreciable discharge from the alluvial groundwater system also occurs in lower Sink Valley in the northwest quarter of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). Sink Valley constricts markedly in this area, which forces shallow alluvial groundwaters flowing down the valley to discharge at the land surface as springs, seeps, and diffuse discharge to the surface (i.e., there is a significant decrease in the cross-sectional area of the alluvial sediments). Groundwater discharge in this area occurs from diffuse seepage to the surface and also as discharges to two springs and several small seeps (Drawing 7-1).

Much of the alluvial groundwater in Sink Valley likely ultimately leaves the valley via evapotranspiration. This conclusion is based on the observation that there is very rarely any discharge of surface water (at least at the surface in the channel) in Sink Valley Wash below Sink Valley (See site SW-9; Drawing 7-2; UDOGM, 2007). The clayey, low-permeability sediments present at the surface over most of Sink Valley also impede appreciable infiltration of precipitation and snowmelt waters into the deeper subsurface. Hence, groundwater recharge to the lower half of the Sink Valley sediments (including the Coal Hollow Mine permit area) likely occurs primarily via horizontal migration of alluvial groundwaters from up-gradient areas.

Flowing artesian groundwater conditions are also observed in monitoring wells screened near the base of the alluvial sediments in the northwest corner of Section 32 T39S, R5W. It is probable that the artesian alluvial groundwater system in Section 29, T39S, R5W is continuous with that in the northwest corner of Section 32. It should be noted that within the Coal Hollow permit area, artesian conditions were not observed in monitoring wells. While the thickness of the alluvial sediments in the artesian groundwater system east of the Coal Hollow permit area range up to 150 feet thick, the thickness of alluvium overlying areas with mineable coal in the Coal Hollow permit area generally does not exceed about 50 feet and in many locations it is considerably thinner.

Natural discharge of alluvial groundwater in the Robinson Creek drainage area is meager. This condition is largely due to the presence of the elevated ridge of impermeable Tropic Shale bedrock associated with the Sink Valley Fault that dissects and effectively isolates the alluvium east of the fault from that west of the fault (See Drawing 6-1). Because of the low permeability of the Tropic Shale, this condition apparently forces alluvial groundwater east of the Tropic Shale ridge to flow to the south toward Sink Valley that would otherwise report to the Robinson Creek drainage. During high flow conditions in the alluvial groundwater system east of the Tropic Shale ridge, minor amounts of groundwater "overtop" the bedrock ridge and drain via surface flow over the Tropic Shale bedrock, where it either recharges shallow alluvial sediments to the west of the fault or is lost to evapotranspiration. The influence of the Tropic Shale ridge is readily evident in field observations, with marked differences in vegetation and soil moisture being apparent on opposite sides of the ridge. During low-flow conditions, discharge from the overtopping of the bedrock ridge has generally not been observed. Isolated areas of soil wetness and shallow perched alluvial groundwater systems that exist west of the bedrock ridge in the northeast corner of Section 30 and the southeast corner of Section 19, T39S, R5W are likely sourced via this mechanism.

Seepage of alluvial groundwater into the deeply incised lower Robinson Creek stream channel occurs near the contact with the underlying Dakota Formation in the southeast quarter of Section 19, T39S, R5W. This water is likely related to saturated alluvial deposits underlying the Robinson Creek stream channel. The alluvial groundwater emerges near where the stream channel intersects the alluvial groundwater system. It is noteworthy that the location of the emergence of alluvial water in the channel has varied somewhat over time. The bank seepage water is likely alluvial groundwater that seeps to the surface where the incised stream channel intersects the potentiometric surface of the alluvial groundwater system. Typically, this is near the contact with the underlying Dakota Formation bedrock in the bottom of the stream channel. Because of the seasonal changes in the elevation of the potentiometric head in the alluvial groundwater system, the location of the bank seepage is variable over time (i.e. the variability in the bank seepage locations are likely controlled primarily by temporal variability in potentiometric levels in the alluvial groundwater system rather than by fixed, permeability-controlled groundwater preferential pathways in the aquifer skeleton). Consequently, the bank seepage locations are not well-defined point sources, but rather dynamic seepage fronts along this general reach of the stream.

The Robinson Creek stream channel above this location is almost always dry (except for in direct response to torrential precipitation events or during the springtime runoff season during wet years. This seepage of alluvial water in the Lower Robinson Creek channel is typically about 5 to 10 gpm or less and is routinely monitored at monitoring station SW-5 (Drawing 7-2).

Information on water quality for groundwaters and surface-waters has been uploaded into the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007) and is summarized and described in Appendix 7-1.

Appreciable spatial variability exists in water quality in groundwaters and surface waters in the Coal Hollow permit and adjacent area. Stiff diagrams depicting solute compositions and overall water quality for groundwaters and surface waters in the Coal Hollow Mine permit and adjacent area are shown in Appendix 7-1. Important water quality characteristics for groundwaters are summarized below.

Groundwater Source	**Chemical type**	**TDS (mg/L)**
Alluvial groundwaters, coarse-grained system east of permit area	Calcium-magnesium-bicarbonate	380 mg/L to 500 mg/L typically, Little seasonal variability
Alluvial groundwaters in south sink valley	Variable, magnesium-bicarbonate sulfate, calcium-magnesium-bicarbonate	450 mg/L to 3,600 typically, Highly variable based on season and climate for shallow systems, less variability in deeper system
Dakota Formation, fault groundwater system south of permit area	Sodium-bicarbonate	500 mg/L to 600 mg/L typically, Little seasonal variability

Water quality characteristics for groundwaters in the proposed North Private Lease area are summarized in Appendix 7-16 as well as Appendix 7-18. It is apparent that the overall water quality of alluvial groundwater degrades from the mountain-front recharge water to the artesian groundwater system east of the Coal Hollow permit area to the non-artesian shallow alluvial groundwater systems located in the more distal portions of Sink Valley. These changes are due to groundwater interaction with soluble minerals in the primarily Tropic Shale-derived sediments that make up the shallow alluvial materials in the permit area.

This down-gradient degradation in water quality is shown graphically on Drawing 7-5. In Drawing 7-5, the average specific conductance values in μS/cm for representative springs and seeps in the Sink Valley drainage are plotted on the map as circles with the circle areas being proportional to the specific conductance average for the spring or seep. The specific conductance information used in generating Drawing 7-5 has been submitted electronically to the Division's hydrology database (UDOGM, 2007). It is readily apparent from Drawing 7-5 that the specific conductance (which is a reflection of the dissolved solids concentration) is degraded from the mountain-front recharge water (represented by stream SW-8) to the artesian alluvial groundwater system in the northwest quarter of Section 29, T5W, R39S, to the alluvial groundwaters in the southern portion of Sink Valley below the Coal Hollow Mine permit area.

Specific conductance values were used for plotting in Drawing 7-5 because specific conductance values are available for all springs and seeps, while laboratory chemical analyses are available for only some of the springs and seeps. Stiff (1951) diagrams for selected springs along this geochemical evolutionary pathway are shown on Figure 14 of Appendix 7-1. It is apparent from the Stiff diagrams and from geochemical information submitted to the Division (UDOGM, 2007) that the mountain-front recharge water (represented by monitoring site SW-8 in upper Swapp Hollow) is of the calcium-magnesium-bicarbonate chemical type with an average TDS concentration of 333 mg/L. Groundwater downgradient of the mountain-front recharge areas in the artesian alluvial groundwater system in Section 29, T5W, R39S, is also of the calcium-magnesium-bicarbonate chemical type, with an average TDS concentration at artesian well Y-61 of 400 mg/L. Further downgradient in the artesian alluvial groundwater system in Section 29, the geochemical composition at SP-8 is of the calcium-magnesium-bicarbonate chemical type with a somewhat increased TDS concentration of 425 mg/L. In the lower portions of Sink Valley in Section 32, T5W, R39S, the chemical quality of the alluvial groundwater is appreciably degraded relative to that in the upper portions of the groundwater system. At spring SP-6, the composition of the alluvial groundwater is seasonally variable and is of the magnesium-bicarbonate-sulfate, or calcium-magnesium-bicarbonate-sulfate chemical type. The TDS concentrations at SP-6 average 970 mg/L. The chemical composition of alluvial groundwater at SP-33 is of a geochemical type similar to that at SP-6, although TDS concentrations are somewhat lower, averaging 795 mg/L. The spatial variability apparent in the TDS concentrations in the alluvial groundwater in Section 32 is likely related to flushing effects resulting from higher groundwater fluxes through zones of increased permeability in the alluvium. It is noteworthy that groundwater in the gravelly zones in the deeper alluvium east of the permit area in Section 32 monitored at the 85-foot deep well LS-85 is considerably lower in TDS concentration with an average of 457 mg/L. The lower TDS concentrations of artesian alluvial groundwater in the deeper, coarser-grained portions of the alluvium are likely attributable to the isolation of these groundwaters from the shallow, clayey, Tropic Shale derived alluvial sediment in the near-surface alluvial groundwaters.

The appreciable temporal variability in the solute geochemical compositions of the shallow alluvial groundwaters in Section 32 is likely attributable to seasonal and climatic variability in the groundwater flux rate through these systems and corresponding variability in rock/water ratios and residence time in the evaporate mineral rich Tropic Shale derived shallow alluvial sediments present in this portion of Sink Valley. Alluvial groundwaters in the deeper portions of Sink Valley to the east in Section 32 are part of a larger, more continuous groundwater system that is hydraulically isolated from overlying shallow recharge sources, and consequently have not exhibited similar temporal variability in solute geochemical composition.

Surface Water Resources

Surface-water resources in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) are described in Appendix 7-1 and are summarized below. Surface-water resources in the proposed North Private Lease area are described in Appendix 7-16.

Surface waters in the Coal Hollow Mine permit and adjacent area, and the proposed North Private Lease area are tributary to Kanab Creek. Surface waters in the northern portion of the existing permit and adjacent area drain into the Robinson Creek and upper Kanab Creek drainages. Surface waters in the southern portion of the permit and adjacent area drain into the Sink Valley Wash drainage which is tributary to Kanab Creek about 6 miles below the Coal Hollow Mine permit area. Surface-water drainages in the permit and surrounding areas are shown in Appendix 7-1. Surface-water drainages in the proposed North Private Lease area are shown in Appendix 7-16. Surface-water baseline monitoring stations are shown on Drawing 7-2. Locations of surface-water water rights in and adjacent to the Coal Hollow Mine permit and adjacent area are shown on Drawing 7-3. Locations of surface-water rights in and adjacent to the proposed North Private Lease are shown on Appendix 7-3N. Water rights data from the Coal Hollow Mine permit and adjacent area are detailed in Appendix 7-3. Water rights data from the proposed North Private Lease and adjacent area are detailed in Appendix 7-3N.

Information on water quality for groundwaters and surface-waters has been uploaded into the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007) and is summarized and described in Appendix 7-1 and Appendix 7-16.

Surface waters in Kanab Creek are used for stock watering and crop irrigation in the irrigable lands adjacent to Kanab Creek west of the Coal Hollow Mine permit area. Discharge in Kanab Creek measured near the town of Alton (SW-1) is seasonally dependent and largely influenced by upstream water use. Discharge in Kanab Creek monitored at SW-1 typically ranges from 10 cfs or less during the springtime runoff period to 1 cfs or less during the summertime.

Discharge in Lower Robinson Creek drainage is meager. Other than during the springtime runoff event in wet years or during torrential precipitation events, flow has not been observed at monitoring stations SW-4 and SW-101 (Drawing 7-2). Discharge at the lower monitoring site on Lower Robinson Creek (SW-5; Drawing 7-2) is meager. The small discharge occasionally present at SW-5 is derived from the seepage of alluvial groundwater into the Lower Robinson Creek stream channel between monitoring sites SW-101 and SW-5.

Tributaries to the Sink Valley Wash drainage in the Coal Hollow Mine permit and adjacent areas include (from north to south) Water Canyon, an unnamed drainage south of Water Canyon in Section 21 T39S, R5W, and Swapp Hollow. Discharge rates in these drainages are highly seasonally dependent (UDOGM, 2007; Appendix 7-1). Discharges in the Water Canyon and Swapp Hollow drainages are intermittent or perennial in nature with discharge peaks occurring during the springtime runoff season and much lower flows occurring during the late summer and fall months. Discharge in the unnamed drainage in Section 21 T39S, R5W is ephemeral.

The water quality and discharge characteristics of surface waters in the Coal Hollow Mine permit and adjacent area are presented in UDOGM (2007) and described in Appendix 7-1. The water quality and discharge characteristics of surface waters in the proposed North Private Lease area are described in Appendix 7-16. Solute compositions of stream waters are also depicted graphically as Stiff diagrams in Appendix 7-1 and Appendix 7-16. The solute compositions of surface waters in the Coal Hollow Mine permit and adjacent area are summarized below. Solute compositions of surface waters in the proposed North Private Lease and adjacent areas are summarized in Appendix 7-16.

Source	Chemical type	TDS (mg/L)
Robinson Creek/Dry Fork	Calcium-magnesium-bicarbonate	300 mg/L typical
Lower Robinson Creek	Variable, magnesium-sulfate-bicarbonate	300 – 3,500 mg/L typical, dependent on discharge
Swapp Hollow	Calcium-magnesium-bicarbonate	250-350 mg/L typical
Kanab Creek	Magnesium-calcium-bicarbonate-sulfate during high flow, variable during low-flow, variability likely due largely to interaction with Tropic Shale soils and irrigation return flows	500-1,300 mg/L typical, Variable dependent on season and irrigation use
Sink Valley Wash	Magnesium-calcium-bicarbonate	600 -1,500 mg/L typical, variable dependent on discharge

Considerable seasonal variability exists in the solute compositions of stream waters in Kanab Creek in the Coal Hollow Mine permit and adjacent area (UDOGM, 2007; Appendix 7-1). During low-flow conditions, interactions between stream waters and Tropic Shale or Tropic Shale-derived alluvial sediments likely result in increased TDS concentrations. Return flow from irrigated fields and interactions with soils rich in soluble minerals also likely contribute to increased TDS concentrations in the summertime. During the spring runoff season, high surface-water flows that originate from the adjacent upland areas dominate the flow in the channel. The TDS concentrations of Kanab Creek waters during high-flow conditions are thus lower than during the low-flow season. Much less seasonal variability in solute content in surface water flows from the mountain stream in Swapp Hollow (UDOGM, 2007; Appendix 7-1). This condition is likely attributable to the fact that the stream in Swapp Hollow, which originates on geologic formations overlying the Tropic Shale, has considerably less contact with the Tropic Shale than does Kanab Creek. Additionally, there are no known irrigation diversions or returns above the stream monitoring point (SW-8; Drawing 7-2) in Swapp Hollow.

722 CROSS SECTIONS AND MAPS

722.100 A map showing the locations of springs and seeps in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) is presented in Drawing 7-1. A map showing the locations of springs and seeps in the North Private Lease area is provided in Appendix 7-16. A map showing potentiometric levels in alluvial groundwater systems in the Coal Hollow and adjacent areas (including the 85.88-acre Dame Lease IBC) is presented in Drawing 7-13. A Map showing potentiometric levels in the North Private Lease area is provided in Appendix 7-16. It is important to note that the alluvial groundwater potentiometric contours depicted in Drawing 7-13 are not representative of a laterally or vertically continuous groundwater system. Within the Coal Hollow Mine permit and adjacent area, appreciable portions of the alluvial sediments are not saturated. Additionally, perched groundwater conditions are present in many locations in the alluvium in the area. In other words, the alluvial groundwater systems in the Coal Hollow Mine permit and adjacent area are not a single, interconnected aquifer. Rather, there exist several areas of saturated alluvium, which may or may not be in good hydraulic communication with adjacent areas. Consequently, it is not possible or meaningful to construct a true potentiometric contour map in the strict sense. Consequently, it is not appropriate to evaluate regional potentiometric trends over large distances or to infer precise groundwater flow directions or hydraulic gradients in the alluvial groundwater system based on Drawing 7-13. The alluvial groundwater system potentiometric map presented in Drawing 7-13 is useful for evaluating approximate local potentiometric conditions and general saturation trends.

722.200 Location of surface water bodies

Within the Coal Hollow Mine permit and adjacent area, no significant natural ponds or lakes occur. The locations of springs and streams are shown in Drawing 7-1. The locations of springs and streams in the North Private Lease area are shown in Appendix 7-16. Many small earthen impoundments and ponds have been created to store surface-water runoff and spring discharge water for stock watering and irrigation use. Some of these impoundments were created by constructing straight or semi-circular berms across ephemeral surface water drainages to impound surface runoff. Because of the character of the alluvial sediments, some of the ponds have become filled with sediment over time and the holding capacities have diminished. The locations of ponds and associated conveyance ditches are shown on Drawing 7-7.

722.300 Baseline monitoring stations

Baseline monitoring stations are shown on Drawing 7- 2. A map showing the locations of monitoring wells in the Coal Hollow permit and adjacent area is presented in Drawing 7-12 and on Figure 12 of Appendix 7-1. The locations and completion details of monitoring wells in the North Private Lease area are provided in Appendix 7-16. Drawing-7-12 also shows monitoring stations from which baseline hydrologic data were collected in previous studies. Monitoring station locations, elevations, and other details are presented in Table 7-1 and Appendix 7-16

722.400 Location of water wells

Water well locations are shown in Drawing 7-2 and Drawing 7-12. Well construction details and locations are presented in Table 7-2. Locations and construction details of water wells in the North Private Lease area are shown in Appendix 7-16.

722.500 Contour map(s) of disturbed area(s)

Surface contours representing the existing land surface configuration of the Coal Hollow permit area (including potentially disturbed areas) are shown on Drawing 5-1 and the post mining land configuration is shown on 5-37. Cross sections with both these landforms are shown on Drawing 5-37A. Surface contours representing the existing land surface configuration of the North Private Lease permit area (including potentially disturbed areas) are shown on Drawing 5-45 and the post mining land configuration is shown on 5-74. Cross sections with both these landforms are shown on Drawing 5-75. The premining landform, with exception of the Facilities area and Lower Robinson Creek, are from an aerial flight that was limited to a five foot contour interval. Therefore, contours have been interpolated down to a 2 foot level using the available aerial flight information. This interpolation provides accuracy for the Division to make the necessary determinations. The Facilities area and portions of Lower Robinson Creek are actual survey data to the accuracy of 2-foot contours.

723 **SAMPLING AND ANALYSIS**

Water quality sampling and analyses have been and will be conducted according to the "Standard Methods for the Examination of Water and Wastewater" or EPA methods listed in 40 CFR Parts 136 and 434. Information regarding laboratory analytical methods utilized in performing water quality analyses at the analytical laboratories has been submitted to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007).

724 **BASELINE INFORMATION**

Baseline groundwater, surface-water, geologic, and climatologic data (including information for the 85.88-acre Dame Lease IBC area) are described in Appendix 7-1 and summarized below. Baseline information for the North Private Lease area are provided in Appendix 7-16.

724.100 <u>Groundwater Information</u>

The location of wells and springs in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) are shown on Drawings 7-1 (Spring and seep survey map), 7-2 (Baseline monitoring locations), and 7-12 (Monitoring well location map). Groundwater rights in and around the Coal Hollow Mine permit area are shown on Drawing 7-3 and tabulated in Appendix 7-3. Groundwater rights information for the North Private Lease area are provided in Appendix 7-3N and shown on Drawing 7-3N.

Seasonal quality and quantity of groundwater and usage is presented in Appendix 7-1 and UDOGM (2007). Baseline discharge and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality (UDOGM, 2007).

Baseline monitoring of groundwater resources in and around the Coal Hollow permit area have been carried out by several entities. Previous hydrologic studies of the region have been made in the Alton Coal Field area by Goode (1964, 1966), Sandberg (1979), Cordova (1981), and Plantz (1983). Selected hydrologic data collected in conjunction with these studies have been incorporated into the hydrologic analysis and baseline data included in this permit application.

During the 1980's, extensive monitoring of groundwater resources in the permit and surrounding areas was performed by Utah International, Inc. Utah International Inc.'s groundwater monitoring activities included the construction of numerous groundwater monitoring wells, aquifer testing activities, and the performance of discharge, water level, and field and laboratory water quality monitoring of springs, seeps, and wells. These baseline monitoring activities were performed as part of a proposed coal mine permitting action in the Alton Coal Field. Ultimately, the proposed coal mining action did not proceed. Relevant monitoring information from the Utah International, Inc. baseline monitoring activities have been included as supplemental baseline data included in this permit application.

Commencing in the 2nd quarter of 2005, regular quarterly baseline monitoring of groundwater resources has been commissioned by Alton Coal Development, LLC. Baseline monitoring of springs, seeps, and groundwater wells in and around the Coal Hollow Mine permit area have been routinely performed. Data collected in the baseline monitoring activities have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007).

Baseline potentiometric information from wells has been input into the DOGM database. For non-flowing-artesian wells, this information has been input in a depth-to-water-relative-to-the-top-of-the-well-casing format using units of feet. For wells experiencing flowing artesian conditions, the potentiometric data are reported to the database in feet as a height-of-the-potentiometric-surface-above-the-top-of-the-well-casing format expressed as a negative number (which makes the flowing-artesian and non-flowing-artesian potentiometric measurements directly comparable). For both conditions, the reported measurements can be directly converted to an absolute water elevation by subtracting the reported value from the elevation of the top of the well casing.

The potentiometric head in monitoring wells experiencing flowing-artesian conditions is measured either 1) by temporarily extending the height of the well casing and allowing the water level to stabilize and the performing a height of the water column measurement (where the artesian pressure is small), or 2) by using a pressure gauge to measure the shut-in artesian pressure in the well and then converting that number to an equivalent height in feet.

During December 2006 and January 2007 an extensive drilling and monitoring well construction program was implemented. This hydrogeologic program included the installation of 30 groundwater monitoring wells in and adjacent to the Coal Hollow Mine permit area. The focus of the drilling program was to characterize the stratigraphy and hydrogeologic properties of alluvial groundwater systems in and adjacent to mining areas. Aquifer characterization of the alluvial groundwater system was also performed using pump testing and slug testing techniques. Investigative methods utilized and the results of the analysis of the data are described in Appendix 7-1.

Descriptions of alluvial groundwater systems in the mine permit and surrounding areas, including information on quantity and quality of alluvial groundwaters, are presented in Appendix 7-1. Estimated rates of alluvial groundwater inflow into the mine are presented in Table 7-9. Additional information on alluvial groundwater inflows is provided in Section 728.333.

As indicated in the Alluvial Groundwater Management Plan for the Coal Hollow Mine (See Appendix 7-9), the land surface overlying proposed alluvial groundwater interceptor drains will be contoured to match the existing surrounding topography. Accordingly, alterations of existing surface-water drainage patterns should not occur.

Water monitoring information provided to the Division demonstrates that water levels in shallow alluvial groundwater systems in the Coal Hollow Mine area do respond to seasonal and climatic variability. However, as described in Appendix 7-1, the shallow alluvial sediments in the Coal Hollow Mine area are dominated by silts, clays, and fine-grained sands which generally do not have appreciable hydraulic conductivity. Because of the overall pervasiveness of silts, clays, and fine-grained sands in the alluvial system in the mine permit area, rates of alluvial groundwater migration are generally not rapid (See information provided in Table 7-9). (It should be emphasized that alluvial groundwater flow velocities in the coarser-grained alluvial systems in areas adjacent to proposed mining areas generally to the east and south are known to be appreciably greater). In cross-sectional exposures of saturated alluvial deposits in the up-gradient highwalls at the Coal Hollow Mine, only modest quantities of groundwater discharge have been observed. Although the alluvial sediments are largely saturated, where the saturated alluvial sediments have been exposed, sustained discharges of alluvial groundwater of more than a few gallons per minute are generally not observed. While discharges on the magnitude of a few gallons per minute have been observed in a fluvial channel system intercepted by the mine (which deposits contained sands, silts, and gravels), the much more pervasive fine-grained alluvial sediments where exposed were observed to weep only very minor, un-measurable quantities of water through the highwall. During a site visit on June 2, 2011, Petersen Hydrologic (2011) estimated that the total flow from the 600-foot-long exposure of clayey, silty alluvium in the mine highwall was less than 1 gpm. The total discharge from the exposed fluvial channel system was measured at 5.5 gpm. The total flow from a recently constructed, 870-foot-long up-gradient alluvial groundwater intercept trench was only 13.4 gpm. What this demonstrates is that, while the alluvial sediments adjacent to the mine openings are largely saturated, the presence of low permeability sediments in the alluvium limits the potential for the alluvial groundwaters to rapidly flow into the mine pit areas.

It should be emphasized here, however, that although highly permeable, saturated, coarse-grained alluvial sediments have not been intersected at the Coal Hollow Mine to date, the potential for intercepting such sediments is always present in heterogeneous mountain-front alluvial deposits. Appreciably greater inflow volumes are possible from such sediments were they to be encountered unexpectedly at the Coal Hollow Mine.

The overall low hydraulic conductivity of most of the alluvial sediments in proposed mining areas generally precludes the effective dewatering of saturated alluvial deposits adjacent to proposed mining areas through the use of vertical dewatering wells. For this reason, as described in the proposed alluvial groundwater management plan for the Coal Hollow Mine, horizontal drain systems (with large, long horizontal “screened” intervals in targeted strata to collect intercepted alluvial groundwater) are proposed for use in dewatering the alluvial sediments adjacent to proposed mining areas.

724.200 Surface Water Information

The locations of streams, stock watering ponds, and conveyance ditches in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) are shown on Drawing 7-7. Surface-water information for the North Private Lease area is provided in Appendix 7-16 and additionally in Appendix 7-18. Surface-water rights in and adjacent to the Coal Hollow Mine permit area are shown on Drawing 7-3 and tabulated in Appendix 7-3. Surface-water rights information for the North Private Lease area are provided in Appendix 7-3N and shown on Drawing 7-3N. Surface-water discharge rates and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007). Additional surface-water information is provided in Appendix 7-1.

It is not anticipated currently that discharge from the Coal Hollow Mine will be necessary. Where necessary, alluvial groundwater that may be intercepted by mining will be placed in drains and diverted away from disturbed areas and discharged (i.e., as groundwater dewatering). However, a Utah UPDES discharge permit will be obtained so that if discharge of mine water becomes necessary, it can be discharged in accordance with the UPDES discharge permit. The exact locations of mine water discharge points will be established upon issuance of the UPDES discharge permit. Any mine discharge water will be placed in either the Lower Robinson Creek drainage or the Sink Valley Wash drainage. Both of these drainages are tributary to Kanab Creek.

As described in R645-301-728.320, acid drainage is not expected from the proposed mining operation (including the proposed operations in the North Private Lease area). This is due to the pervasiveness of carbonate minerals in the mine environment that will neutralize any acid produced.

Seasonal quality and quantity of groundwater and usage is described herein and in Appendix 7-1, Appendix 7-16 and Appendix 7-18. Baseline discharge and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality (UDOGM, 2007).

Baseline monitoring of surface-water resources in and around the Coal Hollow permit area have been carried out by several entities. Previous hydrologic studies of the have been made in the Alton Coal Field area by Goode (1964, 1966), Sandberg (1979), Cordova (1981), and Plantz (1983). Selected hydrologic data collected in conjunction with these studies have been incorporated into the baseline data as part of this permit application.

During the 1980's, extensive monitoring of surface water resources in the permit and surrounding areas was performed by Utah International, Inc. Utah International Inc.'s surface-water monitoring activities included the operation of continuous recording stations on selected streams, and the performance of routine surface-water discharge measurements and field and laboratory water quality analyses. These baseline monitoring activities were performed as part of a proposed coal mine permitting action in the Alton Coal Field. Ultimately, the proposed coal mining action did not proceed. Relevant monitoring information from the Utah International, Inc. baseline monitoring activities have been included as supplemental baseline data as part of this permit application. Commencing in the 2nd quarter of 2005, regular quarterly baseline monitoring of surface-water resources has been commissioned by Alton Coal Development, LLC. Baseline monitoring of surface-waters in and around the Coal Hollow permit area, including surface-water discharge measurements and field and laboratory water quality analyses, have been routinely performed.

All surface waters in the Coal Hollow Mine permit (including the proposed North Private Lease area) and adjacent area are tributary to the Kanab Creek drainage. Surface-water monitoring stations from which baseline data have been collected are shown on Drawing 7-2 and include the following:

Sink Valley Wash drainage

SW-8 (Swapp Hollow above proposed mining areas), SW-7 (unnamed drainage in Section 21, T39S, R5W), RID-1 (irrigation diversion of water from Water Canyon drainage above proposed mining areas), SW-6 (headwaters of unnamed tributary to lower Sink Valley Wash), SW-9 (Sink Valley Wash below proposed mining areas), SW-10 (unnamed tributary to Sink Valley Wash approximately 1.7 miles south of proposed mining areas), SVWOBS-1 (Sink Valley Wash above proposed mining areas, and SVWOBS-2 (Sink Valley Wash east of proposed mining areas).

Lower Robinson Creek drainage

SW-4 (Robinson Creek above proposed mining areas), SW-101 (Lower Robinson Creek near proposed mining areas), BLM-1 (Lower Robinson Creek adjacent to proposed mining areas) and SW-5 (Lower Robinson Creek below proposed mining areas).

Kanab Creek drainage

SW-1 (Kanab Creek near Alton, Utah; above proposed mining areas), SW-3 (Kanab Creek above proposed mining areas), and SW-2 (Kanab Creek below Lower Robinson Creek and below proposed mining areas). Additionally baseline hydrologic data from Lamb Canal, which is an irrigation ditch that conveys water from a diversion in Kanab Creek to irrigated lands adjacent to Kanab Creek west of proposed mining areas, is also collected.

724.300 Geologic Information

Geologic information in sufficient detail to determine the probable hydrologic consequences of mining and determine whether reclamation as required by R645 can be accomplished is given in Chapter 6 of this permit application package and in Appendix 7-1, Appendix 7-16 and Appendix 7-18.

724.400 Climatological Information

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 two 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 are summarized in Table 7-3. Climatological data from the Coal Hollow Mine permit and adjacent area are plotted in Drawing 7-8.

An automated weather station was installed in the Coal Hollow Mine permit area in December 2005. The station is configured to continuously monitor and record temperature, wind velocity, and wind direction data. The station is also configured to continuously measure and record precipitation, although the tipping rain-gauge is not operative during winter months. Climate data from the Coal Hollow Mine and adjacent area are also presented in Appendix 7-6.

724.411 Seasonal precipitation

Precipitation data from the Alton, Utah weather station indicates average annual precipitation of 16.38 inches per year. Doelling (1972) reports average annual precipitation in the Alton Coal Field area ranging from 9 to 20 inches annually with slightly higher increments likely in the higher parts of the plateau (Doelling, 1972). There are generally two annual wet periods in the region. During the wintertime, cyclonic storms bring precipitation (mainly snowfall) to the region. During the summertime, storms originating from convection of air from the Gulf of Mexico or the Pacific Ocean bring rains to the region. Of the two annual wet cycles, the summer rainfall is most reliable. Average monthly precipitation at the Alton station ranges from a low of 0.57 inches in June to a maximum of 1.80 inches in February. Daily temperature and precipitation data recorded at the Coal Hollow Project weather station during 2006 and early 2007 are presented in Appendix 7-6.

The Palmer Hydrologic Drought Index (PHDI; NCDC, 1997) indicates long-term climatic trends for the region. The PHDI is a monthly value generated by the National Climatic Data Center (NCDC) that indicates the severity of a wet or dry spell. The PHDI is computed from climatic and hydrologic parameters such as temperature, precipitation, evapotranspiration, soil water recharge, soil water loss, and runoff. Because the PHDI takes into account parameters that affect the balance between moisture supply and moisture demand, the index is a useful for evaluating the long-term relationship between climate and groundwater recharge and discharge. A plot of the PHDI for Utah Region 4 (which includes the Coal Hollow Mine permit and surrounding area) is shown in Drawing 7-9. It is apparent in Drawing 7-9 that the region has experienced cyclical periods of drought and wetness since 1980. Baseline hydrologic monitoring performed by Utah International, Inc in 1987 and 1988 occurred during a period of near normal wetness. Recent baseline hydrologic monitoring conducted in 2005 and 2006 occurred during a period of moderate to severe wetness, with 2005 being wetter than 2006.

724.412 Wind direction and velocity

Wind data have been collected at the Coal Hollow Project weather station since December 2005. Monthly wind data from the Coal Hollow Project weather station are available from January 2006 through March 2006, and from November 2006 through May 2007. Monthly wind data are plotted as wind rose diagrams, which depict the average direction and velocity of prevailing winds, in Appendix 7-1. Based on recent data from the Coal Hollow Project weather station, it is apparent that the predominant wind direction in the Coal Hollow Mine permit area (during the months for which data are available) are from the northeast, with secondary peaks from the north and south-southwest (Appendix 7-6). Surface winds recorded at the Coal Hollow Project weather station averaged about 6.4 miles per hour. Tabulated hourly wind data from the Coal Hollow Project weather station are maintained on file at Alton Coal Development, LLC.

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 area average approximately 8 miles per hour. Higher wind speeds are associated with fronts and storms and generally occur during the springtime.

724.413 Seasonal temperature ranges

Temperature data from the region are summarized in Table 7-3. Temperatures in the permit area vary greatly. Temperature data from the Alton station (1928-2005) indicate that monthly average low temperatures are below freezing for the 6-month period from November to April. Monthly average minimum temperatures range from a low of 15.1 °F during January to a high of 49.8 °F in July. Monthly average maximum temperatures range from a low of 39.5 °F in January to a high of 82.6 °F in July. Daily maximum and minimum temperature data collected at the Coal Hollow Project weather station during 2006 through August 2015 are presented in Appendix 7-6. The maximum temperature recorded during this period was 94.1 °F in June 2013. The minimum temperature recorded during this period was -8.4 °F in January 2011.

724.500 Supplemental Information

Other than the possible short-term diminution in discharge rates from alluvial groundwater systems, including the potential short-term diminution of discharge rates from some springs and seeps in Sink Valley, adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur. Significant adverse impacts to the hydrologic balance in the North Private Lease are likewise not anticipated, although one seep that discharges at less than 1 gpm is planned to be intercepted by the mine workings. It is not anticipated that acid- and toxic-forming materials will cause significant contamination of groundwater or surface-water supplies in either the existing mine area or at the proposed North Private Lease. Any discharges of mine waters to surface-water systems will be regulated under and meet the criteria of a UPDES discharge permit. The mining and reclamation plan for the existing mine area and the proposed North Private Lease has been designed to minimize the potential for disturbance or disruption of the hydrologic balance and to protect groundwater and surface-water resources in the area.

If substantial alluvial groundwater inflows into mining areas occur as mining progresses in close proximity to alluvial springs and seeps in the eastern ¼ of Section 30, T39S, R5W and the northwest ¼ of Section 29, T39S, R5W or in close proximity to coarse-grained alluvial sediments in the artesian groundwater system along the eastern side of Sink Valley, Alton Coal Development, LLC will evaluate hydrogeologic conditions at the time such may occur. It should be noted that very large discharges into mine workings are not anticipated based on the results of recent drilling and aquifer testing performed in these areas (see Appendix 7-1). Based on the hydrogeologic conditions encountered, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine, which may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to protect groundwater resources up-gradient of mining activities. The potential for success of such protective measures in minimizing drainage of alluvial deposits up-gradient of proposed mining areas is believed to be good, given that the thickness of the alluvium in these areas is generally on the order of about 20 to 50 feet and these sediments are directly underlain by essentially impermeable Tropic Shale in proposed mining areas. It is important to note that while temporary impacts to groundwater discharge rates from alluvial springs and seeps could possibly occur, these impacts will likely be short-lived. This conclusion is based on the fact that individual mine pits in most instances will remain open for no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). The variability in the time individual pits remain open is related to the thickness of overburden at the pit and the state of the overall spoil balance. It should be noted that these times could be somewhat greater if the mining production rate is less than the currently anticipated rate (in the event that contracts for the full 2 million tons of coal per year are not in place). However, the backfilling and rough grading requirements of R645-301.553 will be met (except where a variance to this regulation has been requested to assist with the transition to the adjacent federal coal reserves in the south pits area). After mine pits are backfilled and reclaimed, the potential for appreciable continued drainage of up-gradient alluvial groundwater through the backfilled pits in that area is low. When mining is complete in an area, seasonal recharge to alluvial groundwater systems will gradually replenish groundwater to the alluvial groundwater system. Large-scale dewatering of the alluvial groundwater system, such that appreciable compaction of the aquifer skeleton could occur, is not anticipated (see Appendix 7-1).

If diminution of discharge rates from seeps and springs does occur as a consequence of mining and reclamation activities in either the existing mining area or the proposed North Private Lease, any lost water will be replaced according to all applicable Utah State laws and regulations using the water replacement source specified in R645-301-727. The quantity and quality of replacement water detailed in R645-301-727 will be suitable for the existing premining uses and approved postmining land uses.

It should be noted that the Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of groundwater or surface-water resources, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

If excess groundwater were to be encountered during mining operations in the existing permit area or in the proposed North Private Lease such that it could not be adequately managed or discharged in compliance with the Utah UPDES discharge permit (which is considered unlikely), Alton Coal Development, LLC may when necessary and with the approval of the Utah Division of Oil, Gas and Mining construct supplemental containment and settlement ponds in which mine discharge waters may be held for treatment (where necessary) and subsequent discharge through UPDES discharge points in compliance with the UPDES discharge permit.

Mining in the Coal Hollow project area will be a combination of surface mining, either open pit or highwall mining, and underground mining. Both the highwall mining and underground mining are designed such that subsidence is not expected to occur or have a negative impact on renewable resources lands.

724.700 Alluvial Valley Floor Determination

A field investigation has been performed in the Coal Hollow Mine permit and adjacent area to provide to the Division the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the Coal Hollow Mine permit and adjacent area. The results of this field investigation and related information is provided in Appendix 7-1. Additional information regarding potential alluvial valley floors in the area is provided in Appendix 7-7.

A report detailing the findings of a previous field investigation performed by Water Engineering & Technology, Inc., entitled “Geomorphological and sedimentological characteristics of Sink Valley, Kane County, Utah” is included as Appendix 7-4.

A field investigation has been performed in the North Private Lease Area and adjacent area to provide to the Division the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the North Private Lease permit and adjacent area. The results of this field investigation and related information is provided in Appendix 7-17.

725 BASELINE CUMULATIVE IMPACT AREA INFORMATION

Appendix 7-1 contains the results of a comprehensive investigation of groundwater and surface-water systems in the Coal Hollow Mine permit and adjacent area (including the

85.88-acre Dame Lease IBC area, and the proposed North Private Lease area). Appendix 7-1 also includes information regarding the probable hydrologic consequences of coal mining in the Coal Hollow Mine permit area and recommendations for hydrologic monitoring. Appendix 7-1 also includes the results of a field investigation performed in the Coal Hollow Mine permit and adjacent area to provide to the Division of Oil, Gas and Mining the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the Coal Hollow Mine permit and adjacent area. This Information together with the information submitted herein can be used to assess the probable cumulative hydrologic impacts of coal mining and reclamation operations in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) as required by R645-301-729. The results of a field investigation regarding potential alluvial valley floors in the proposed North Private Lease area was previously provided to the Division and is included in the MRP as Appendix 7-17. The AVF report includes baseline information for the North Private Lease area including groundwater and surface-water quality information. The report also includes geologic information including maps of geology and geomorphology of the North Private Lease and Adjacent area.

Information on groundwater and surface-water systems in the North Private Lease area at the North Private Lease area is provided in Appendix 7-16 (Petersen Hydrologic, 2015) and Appendix 7-18. Appendix 7-16 includes a map showing hydrologic baseline monitoring locations as well as a map showing spring and seep locations in the North Private Lease and adjacent areas. A plot of the Palmer Hydrologic Drought Index and a geologic map of the North Private Lease and adjacent area are provided in Appendix 7-16. Appendix 7-16 also provides a series of hydrogeologic cross-sections through the North Private Lease and adjacent area that show water levels under seasonal conditions. Discharge hydrographs for springs and streams and water level hydrographs for wells are provided in Appendix 7-16. Baseline water quantity and water quality data for springs, streams, and wells in the North Private Lease and surrounding areas are tabulated in Appendix 7-16. A map showing Stiff diagrams that depict solute geochemical compositions for groundwaters and surface waters in the North Private Lease and surrounding areas is provided in Appendix 7-16. A map showing the locations of ponds and ditches is also provided. Plots of TDS concentrations in Kanab Creek during high flow and low flow conditions are provided in Appendix 7-16, as is a graph of discharge rates plotted versus TDS in the creek. A water table map is also provided in Appendix 7-16. Monitoring well details for wells in the North Private Lease area are also provided in Appendix 7-16. A map showing the proposed hydrologic monitoring locations associated with the North Private Lease area is also provided in Appendix 7-16.

R645-301-726 Modeling

No numerical models have been created for the permit area ~~nor are any planned~~.

727 ALTERNATIVE WATER SOURCE INFORMATION

This section provides information on the alternative water source that will be used to replace water from groundwaters or surface waters should they be impacted by mining and reclamation activities in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area, and the North Private Lease area).

The alternative water source is a water production well that was constructed on private land leased by Alton Coal Development, LLC in the northwest quarter of Section 29, Township 39 South, Range 5 West. The location for the well, which is situated within the Coal Hollow Mine permit area, is shown on Drawing 5-8C. The well produces water from the alluvial groundwater system in Sink Valley in locations up-gradient of proposed mining operations. Based on aquifer testing performed in the alluvial groundwater system near the proposed water well (using the existing well Y-61 as a pump testing well), it is believed that adequate water can be produced from the new well to satisfy the potential water replacement needs of the mine. Details of the aquifer testing and information on the hydrogeologic characteristics of the Sink Valley alluvial groundwater system are presented in Appendix 7-1.

Water quality data from the Sink Valley alluvial groundwater system near the location of the new water well have been collected from well Y-102 and have been submitted electronically to the Utah Division of Oil, Gas and Mining Utah Coal Mining Water Quality Database (UDOGM, 2007). The quantity and quality of water produced from the new water production well has been suitable for the existing premining uses and approved postmining land uses. Well testing performed on the new water well indicated a yield of 150 gpm (see well driller's report for well ID 434305 and water right 85-774 on file at the Utah Division of Water Rights and at waterrights.utah.gov).

It should be noted that the water replacement well source produces water from the coarse-grained alluvial groundwater system in Sink Valley. Nearby springs that could potentially be impacted by mining and reclamation activities are supported by the same alluvial groundwater system. However, while modest decreases in the artesian hydraulic pressures in the alluvial groundwater system could potentially result in diminution of spring flows, the planned new water well will likely be approximately 100 feet deep and will be equipped with an electric well pump giving it the capacity to produce groundwater from the alluvial system even if the hydraulic head in the area were to be diminished such that artesian flow conditions temporarily ceased to exist.

An analysis of the total average discharge of state appropriated groundwaters from the permit and adjacent area has been performed to determine whether the quantity of water that could likely be produced from the new water replacement well will be adequate for potential replacement needs. Based on baseline spring discharge data submitted to the Division (UDOGM, 2007), it is determined that the average discharge of all state appropriated groundwater from groundwater discharge area A (Drawing 7-3, Drawing 7-4) is approximately 35 gpm. The state appropriated waters in groundwater discharge

Area A include most of the significant springs in the area and essentially all of the largest springs in the area (Drawing 7-3; Appendix 7-3). The average discharge of all state appropriated groundwater from groundwater discharge area B (Drawing 7-4) is approximately 17 gpm. Using an unlikely worst-case scenario and assuming that all springs with state appropriated waters in both Areas A and B were to cease flowing, a total replacement of approximately 52 gpm would be required. The proposed new water well located in Section 29, Township 39 South, Range 5 West will be designed to produce water at that quantity and, therefore, should be able to provide adequate replacement water in even this worst-case scenario (which is not considered likely). Aquifer analysis described in Appendix 7-1 suggests that the yield of the alluvial groundwater system in which the new water well will be constructed should be capable of sustaining discharges of the required magnitude and for the lengths of time that the need for replacement water would be likely. It should be noted that if the need arises to provide replacement water for impacted state appropriated waters, the duration of the need will likely be of a relatively short duration (see Section 728 below).

Alton Coal Development, LLC has entered into a written agreement with the town of Alton, Utah to transfer the point of diversion for 50 acre-feet of water for use at the Coal Hollow Mine. A copy of this agreement is included in Appendix 7-8 (in confidential binder). This water available for all uses at the mine including potential use for water replacement. The new water well has been constructed on lands currently leased by Alton Coal Development, LLC. Consequently, no new landowner access agreement will be required for the drilling of the well.

728 PROBABLE HYDROLOGIC CONSEQUENCES (PHC) DETERMINATION

This section describes the probable hydrologic consequences of surface coal mining in the Coal Hollow Mine permit area. This determination is based on data presented herein and on information provided in Appendix 7-1. The probable hydrologic consequences associated with proposed highwall mining activities within the 85.88-acre Dame Lease IBC area are presented in Appendix 7-4. The probable hydrologic consequences associated with the proposed underground mining activities at the Coal Hollow Mine are presented in Appendix 7-15. The probable hydrologic consequences of proposed coal mining and reclamation activities in the North Private Lease area are presented in Appendix 7-16 and further characterization and analysis of the alluvial groundwater systems in the North Private Lease are shown in Appendix 7-18. This mining and reclamation plan has been designed to minimize potential adverse impacts to the hydrologic balance. It should be noted that this PHC and also Appendix 7-1 may be updated periodically as required as additional hydrogeologic information and mining data become available in the future.

728.310 Potential adverse impacts to the hydrologic balance

Other than the possible short-term diminution in discharge rates from alluvial groundwater systems, including the potential short-term diminution of discharge rates from some springs and seeps in Sink Valley, appreciable adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur. The basis for this determination is discussed below.

As discussed in Section 721 above, minimal groundwater resources exist in the Tropic Shale, which directly overlies the coal reserves in proposed mining areas. Groundwater in the Tropic Shale does not provide measurable baseflow discharge to streams in the area. The lack of appreciable groundwater flow in the Tropic Shale is a result of the poor water transmitting properties of the marine shale unit. Consequently, it is anticipated that little groundwater will be encountered in the Tropic Shale in mining areas. Thus, the potential for adverse impacts to the hydrologic balance resulting from mining through the Tropic Shale in the Coal Hollow Mine permit area is minimal.

Similarly, as described in Section 722 above, groundwater resources in the Dakota Formation underlying the coal seam to be mined are not appreciable. This condition is fundamentally a result of the heterogeneity of the rock strata in the Dakota Formation which impedes the ability of the formation to transmit groundwaters significant distances vertically or horizontally. The presence of the essentially impermeable Tropic Shale on top of the Dakota Formation also minimizes the potential for vertical recharge to the Dakota Formation. Mining operations will remove the overlying Tropic Shale rock strata from the Dakota Formation in addition to the Smirl coal seam deposit at the top of the Dakota Formation in mined areas. However, because the pre-mining hydraulic communication between the Tropic Shale and the underlying Dakota Formation in planned mining areas is believed to be minimal, the removal of the Tropic Shale overburden and Smirl coal seam from the Dakota Formation, followed by the rapid backfilling of pit areas with low-permeability fill materials should not result in adverse impacts to the hydrologic balance in the Dakota Formation (i.e., the post-mining degree of hydraulic communication between the Dakota Formation and the overlying low-permeability backfill material will be similar to that of the pre-mined condition).

It should be noted that the first water-bearing strata underlying the coal seam to be mined in the Coal Hollow Mine permit area from which appreciable quantities of groundwater can be produced is the Navajo Sandstone. The Navajo Sandstone aquifer is of regional significance in that it provides groundwater of good quality to domestic, agricultural, and municipal wells regionally and provides baseflow to springs and streams. The Navajo Sandstone does not crop out in the Coal Hollow Mine permit and adjacent area. The formation is effectively isolated from proposed mining areas by more than 1,000 feet of rock strata of the Dakota and Carmel Formations (which includes large thicknesses of low-permeability shales and siltstones). The Navajo Sandstone aquifer will not be impacted by proposed mining operations. It should be noted that some previously proposed mining operations in the Alton Coal Field have proposed drilling and pumping of large amounts of groundwater from high-capacity production wells in the Navajo Sandstone aquifer for operational use. No such wells are planned in the Coal Hollow Mine permit and adjacent area.

Of primary importance to the hydrologic balance in the Coal Hollow Mine permit and adjacent area are alluvial groundwater systems. As discussed in Section 722 and in Appendix 7-1, alluvial groundwater systems in the area support springs, seeps, diffuse groundwater discharge, and a limited number of wells. The bulk of the alluvial groundwater flux through the area occurs in alluvial sediments that include coarse-grained and finer-grained sediments near the eastern margins of Sink Valley, east of the Coal Hollow Mine permit area. Lesser quantities of alluvial groundwater migrate through finer-grained alluvial sediments (predominantly clays, silts, and sands) in the western portions of Sink Valley and in the Lower Robinson Creek drainage within the Coal Hollow Mine permit area. Discharges from alluvial groundwater systems in Sink Valley do not contribute measurable quantities of baseflow to streams (at least at the surface in the stream channel). Alluvial groundwater systems in the Lower Robinson Creek area are much less extensive than the alluvial groundwater systems in Sink Valley. Other than the emergence of small quantities of alluvial groundwater from the stream banks where the stream channel intersects the alluvial groundwater system, discharge from the alluvial groundwater system as springs or seeps in Lower Robinson Creek is generally not observed. Perched groundwater conditions exist locally in the alluvial groundwater system in the Lower Robinson Creek drainage.

In the general sense, surface coal mining activities in the Coal Hollow Mine permit area have the potential to impact groundwater systems primarily through three mechanisms:

1) Where water-bearing strata in proposed mining areas are mined through, groundwater systems within these strata will obviously be directly intercepted,

2) Where groundwater flow paths through mine openings are interrupted, groundwater flow in down-gradient areas could be diminished, and
3) Where mine openings intercept permeable strata, groundwater resources in up-gradient areas could potentially be diminished if appreciable quantities of groundwater were to be drained from up-gradient areas.

The potential for the occurrence of each of these potential impacts are described in the following.

Direct Interception of Groundwater Resources

As discussed above, groundwater resources in the relatively impermeable Tropic Shale in the proposed permit area are meager. Consequently, it is improbable that direct interception of appreciable groundwater in the Tropic Shale will occur. Additionally, because Tropic Shale groundwater systems generally do not support discharges to springs or provide baseflow to streams, the potential interception of limited quantities of groundwater in the Tropic Shale will not adversely impact the hydrologic balance. Similarly, groundwater resources in the Dakota Formation (including within the Smirl coal seam) are meager. While the Smirl coal seam will be extracted through mining operations, the underlying strata of the Dakota Formation will not be disturbed. Consequently, adverse impacts to groundwater systems in the Dakota Formation through direct interception of groundwater resources are not anticipated.

Alluvial groundwater systems in planned mining areas in the Coal Hollow Mine permit area will be directly intercepted by the mine openings. It is not anticipated that the direct interception of shallow alluvial groundwater will adversely impact the overall hydrologic balance in the region. This is because no substantial springs, seeps or other important groundwater resources have been identified in proposed mine pit areas (Drawing 7-1). In the pre-mining condition, any diffuse groundwater discharge to the ground surface that occurs is primarily lost to evapotranspiration and does not contribute appreciably to the overall hydrologic balance in the area.

Because of the prevailing low-permeabilities of the alluvial sediments within the proposed mine disturbance area, it is unlikely that the direct mining of the alluvial groundwater system within these areas could cause impacts to subirrigation and soil moisture contents in up-gradient areas.

It is considered likely that the average hydraulic conductivity of the placed run-of-mine backfill material will be low. This is because of the pervasiveness of low-permeability, clay-rich materials in the mine overburden and the anisotropic nature of the placed fill material. Consequently, the potential for the migration of appreciable quantities of groundwater through the fill is considered low. Accordingly, the potential for impacts to subirrigation and soil moisture in the lands up-gradient of mining areas will be minimized by the placement of the low-permeability backfill.

An engineered low-permeability barrier previously planned for the eastern edge of pit 15 will no longer be necessary and will not be constructed. The original purpose of the proposed engineered barrier was to minimize the potential for long-term impacts to the alluvial groundwater system in Sink Valley up-gradient of mining areas that could occur as a result of the long-term draining of alluvial groundwater into the pit backfill area. Because surface (pit) mining in those areas adjacent to the Sink Valley alluvial groundwater systems (pits13, 14, and 15) is no longer planned, such a barrier will not be necessary.

The potential for short-term impacts to subirrigation and soil moisture in the lands up-gradient of proposed mining areas will be minimized through the implementation of the hydrology resource contingency plan described in Appendix 7-9.

Diminution of down-gradient groundwater resources

Where groundwater flow paths that convey groundwater to down-gradient areas exist in areas that will be mined, there is the potential that diminution of down-gradient groundwater resources could occur. In the Coal Hollow Mine permit area, it is considered unlikely that appreciable diminution of down-gradient resources will occur as a result of mining and reclamation activities. The basis of this conclusion is presented below.

Groundwater resources in the Tropic Shale are meager and groundwater flow rates are very slow through the marine shale unit. Groundwater systems in the Tropic Shale do not support appreciable spring or seep discharge nor do they provide measurable baseflow to streams down-gradient of mining areas. Consequently, the potential for adverse impacts to the hydrologic balance as a result of mining through Tropic Shale is considered minimal.

Similarly, groundwater resources in the Dakota Formation are meager. The potential for lateral and vertical migration of groundwater through the formation is limited by the pervasiveness of low-permeability shaley strata in the formation and the lateral discontinuity of permeable strata. Groundwater systems in the Dakota Formation do not support appreciable spring or seep discharge nor do they provide measurable baseflow to streams down gradient of mining areas. Additionally, with the exception of the relatively low-permeability Smirl coal seam located at the top of the formation, groundwater systems in Dakota Formation rock strata below the coal seam will not be disturbed by mining and reclamation activities. Consequently, the potential for adverse impacts to the hydrologic balance as a result of mining through Dakota Formation strata is considered minimal. It should be noted that spring SP-4 discharges at about 1 gpm approximately 1.1 miles south of the Coal Hollow Mine permit area from an apparent fault/fracture system in the Dakota Formation that may be related to the Sink Valley Fault. It is unlikely that appreciable migration of groundwater through the Sink Valley Fault system in the relatively impermeable Tropic Shale or shallow alluvium in the Coal Hollow Mine permit area occurs. Consequently, it is considered unlikely that mining and reclamation activities in the Coal Hollow Mine permit area will cause a diminution of discharge from spring SP-4.

Alluvial groundwater systems in proposed mining areas area supported primarily by clays, silts, and fine-grained sands. In proposed mining areas in Sink Valley, appreciable coarse-grained alluvial sediments were not encountered in drill holes or back-hoe excavations. Significant layers of clean coarse alluvium, which could rapidly convey significant amounts of groundwater, were likewise not observed. The results of slug testing performed on wells in and adjacent to proposed mining areas likewise suggest that the potential for rapid migration of groundwaters through alluvial sediments in proposed mining areas is low (Tables 7-8 and 7-9). These data and observations suggest that the flux of groundwater migrating through the alluvial sediments in proposed mining areas in Sink Valley (that could support down-gradient groundwater systems) is not large. Much of the groundwater migrating through the alluvial sediments in proposed mining areas (in the East ¼ of Section 30, T39S, R5W) likely leaves the groundwater system through diffuse discharge to the land surface and is lost evapotranspiration and does not contribute to the overall hydrologic balance in the area. In Sink Valley, a preferential pathway for alluvial groundwaters through deep coarse-grained alluvial sediments likely exists along the east side of Sink Valley. While the thickness of the alluvium in proposed mining areas in Sink Valley generally does not exceed 50 feet (and in many locations is much less), the alluvial sediments along the eastern side of Sink Valley adjacent to proposed mining areas range from about 120 to 140 feet. Of the total flux of groundwater through the alluvial groundwater systems in Sink Valley, most of the flux is likely through this coarse-grained portion of the system. The percentage of the total flux that migrates through clayey and silty alluvial sediments in proposed mining areas along the western flanks of Sink Valley is likely much less.

It should be noted that highly permeable strata were encountered from about 60 to 75 feet depth just above the bedrock interface at the SS well cluster (monitoring well SS-75; Table 7-2). This well is screened in an area of burned or eroded coal (the coal is absent) and consequently, mining will not occur at this location. The coal seam is present at the nearby C9 cluster area. Were mining operations to intercept this highly permeable zone, substantial groundwater inflows into the mine openings could occur. Consequently, prior to surface mining in this area, the boundary between the competent coal seam and the area of burned or eroded coal will be more precisely defined by drilling or other suitable techniques such that mine openings can be designed to avoid these areas of potentially large groundwater inflows.

As discussed in Section 722 above, alluvial groundwater from Sink Valley discharges to several springs and seeps and as diffuse discharge to the ground surface in the northwest ¼ of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). This groundwater discharge is likely a result of the constriction in Sink Valley in this area and the corresponding decrease in the cross-sectional area of the alluvial sediments in the valley, which forces groundwater to discharge at the surface. Most of the groundwater discharge in this area is likely derived from the up-gradient alluvial groundwater systems in the eastern portion of the valley (i.e., the coarse-grained portion of the alluvial groundwater system), which is situated east of the Coal Hollow Mine permit area. This conclusion is based on 1) the substantially larger cross-sectional area of the alluvium in the deeper eastern portion of the valley relative to that in proposed mining areas near the western margins of the valley, 2) the higher hydraulic conductivity of the sediments in the coarse-grained part of the alluvial system, and 3) the lack of other apparent discharge mechanisms for the coarse-grained system further downstream in Sink Valley Wash (i.e., there are no significant alluvial springs or seeps further downstream in Sink Valley Wash and the system apparently does not contribute measurable baseflow to Sink Valley Wash further downstream (at least at the surface in the stream channel, as evidenced by the lack of baseflow in the wash monitored at SW-9).

Because most of the alluvial groundwater discharge supporting springs and seeps in this area is likely not derived from groundwater systems that underlie planned mining areas in the Coal Hollow Mine permit area, it is considered unlikely that discharges from the springs and seeps in northwest ¼ of Section 32 T39S, R5W will be appreciably diminished as a result of the proposed mining and reclamation activities. While considered unlikely, some temporary impacts to discharge rates from springs and seeps in this area are possible. In particular, it should be noted that mining in the southernmost portions of the Coal Hollow Mine permit area has a somewhat greater potential to decrease groundwater discharge rates at spring SP-6, which is located about 600 feet below the southernmost proposed mining areas (Drawing 7-2). SP-6 is an alluvial seep which has been impounded with an earthen dam from which measurable discharge is generally not present.

It is critical to note that individual mine pits in this area will remain open for short lengths of time, generally no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). Mining operations in the vicinity near the alluvial groundwater discharge area in the northwest ¼ of Section 32 T39S, R5W are planned to be completed in about 1 year. Thus, any potential impacts to discharge rates from down-gradient groundwater systems will be short-lived. Following the backfilling and reclamation of mine openings, the potential for interception or re-routing of alluvial groundwater away from the groundwater discharge area in northwest ¼ of Section 32 T39S, R5W will be negligible. As stated above, most of the flux through the Sink Valley alluvial groundwater system that supports springs and seeps in the area occurs in the eastern portion of the valley, which will not be impacted by mining and reclamation activities. Consequently, long-term impacts to discharge rates from springs and seeps in this area are not anticipated. It should also be noted that if increased quantities of groundwater were to be encountered in mine workings in lower Sink Valley such that the water would need to be discharged to surface drainages, the mine water will ultimately be discharged to the Sink Valley Wash drainage (i.e., the water will remain in its drainage basin).

Alluvial groundwater systems in the Lower Robinson Creek area are much less extensive than the alluvial groundwater system in Sink Valley. Perched groundwater conditions exist locally in the alluvial groundwater system in the Lower Robinson Creek drainage. Other than the re-emergence of alluvial groundwater flowing beneath the Lower Robinson Creek stream channel where the stream channel exists directly on bedrock substrate, discharges from the alluvial groundwater system as springs or seeps in Lower Robinson Creek are not observed. Consequently, mining operations in the Lower Robinson Creek drainage will likely not result in diminution of down-gradient groundwater resources.

It should be noted that the Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of groundwater or surface-water resources, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

If any Utah State appropriated water rights are impacted by mining and reclamation operations in 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 Section 727 above.

Draining of up-gradient groundwater resources

Where surface mining occurs adjacent to up-gradient groundwater systems, there is a potential that draining of groundwater from the up-gradient groundwater system into the mine voids could occur. This condition could occur if a sufficiently large and permeable stratum were to be intercepted that is in good hydraulic communication with the up-gradient groundwater system through which appreciable quantities of water could be transmitted.

To more fully evaluate the potential for draining of up-gradient groundwater resources, a field investigation was performed during the winter of 2006-2007 that was designed to facilitate the characterization of the alluvial groundwater system in the Coal Hollow Mine permit and adjacent area. Specifically, this program was designed 1) to better define the vertical and lateral extent of permeable, coarse-grained sediments in the alluvial groundwater system, 2) to characterize the water bearing and water transmitting properties of alluvial sediments, and 3) to evaluate the degree of hydraulic communication between the coarse-grained portion of the alluvial system in Sink Valley and the clayey alluvial sediments in proposed mining areas.

This field investigation included 1) the drilling and installation of 30 monitoring wells, 2) the performance of a 28-hour pumping and recovery test on the alluvial testing production well Y-61 (which is a 6.625-inch well constructed in 1980 as part of a previous coal mining application for groundwater pumping for alluvial aquifer testing) with contemporaneous measuring of water levels in the monitoring well network and contemporaneous measuring of spring discharge rates at three alluvial springs, and 3) the slug testing of 20 monitoring wells to determine approximate values of hydraulic conductivity. The results of the field investigation including analysis of the data collected in the investigation are presented in Appendix 7-1 and are summarized below.

Other than occasional pebbles or small rocks, coarse-grained sediments (i.e., gravels and coarse sands) were not encountered in the drilling of wells along the eastern margins of proposed mining areas in Sink Valley (C1, C2, C3, and C4 well clusters). (It should be noted that the C2 well cluster is located west of the eastern limit of the mine disturbance. The mine openings will intercept the C2 well cluster and the area to the east to locations west of well Y-102). Rather, the sediments encountered in the drilling of these wells were dominated by clays and silts with subordinate amounts of fine-grained sand. Similarly, coarse-grained deposits were not encountered in well clusters C6, C7, C8, and C9. There was no indication during drilling of any appreciable thickness of highly permeable strata through which groundwater could rapidly be transmitted (although it should be noted that the presence of thin sand layers are difficult to identify in wet auger drilling returns). Similarly, appreciable amounts of high-permeability coarse-grained alluvial sediments were not noted in alluvial sediments investigated in backhoe excavated pits and erosional escarpments in Sink Valley.

The hydraulic heads measured in alluvial monitoring wells near proposed mining areas in Sink Valley (C2, C3, C4, C7, C8, and C9) did not indicate artesian pressures. Rather, marked upward or downward vertical hydraulic gradients were not observed in any of these areas and water levels were consistently within several feet of the ground surface.

The results of pump testing in the alluvial groundwater system demonstrate that the springs in the northwest ¼ of Section 29, T39S, R5W are in direct hydraulic communication with the coarse-grained alluvial groundwater system in which the pumping well Y-61 is screened. Discharge rates (or water levels at Sorensen Spring) measured at each of the four springs (SP-8, SP-14, SP-20, and Sorensen spring) monitored during the 28-hour pumping test responded to pumping at the well. Monitoring wells at clusters C2, C3, and C4 near the easternmost proposed mining areas also showed small, muted responses, with declines measured in water levels during the 28-hour test ranging from about 0.05 to 0.10 feet. Other monitoring wells in proposed mining areas did not respond measurably to pumping at Y-61. It should be noted that after the pumping well was turned off at the end of the 28-hour pumping test, spring discharge rates and water levels in alluvial monitoring wells recovered to approximate pre-testing levels.

The results of slug testing of wells in the Coal Hollow Mine and adjacent area are presented in Table 7-8. Using these hydraulic conductivity values together with measured thicknesses of saturated alluvial sediments determined during drilling, and hydraulic gradient values determined from water levels measured in monitoring wells, rates of estimated groundwater inflows to mine openings have been calculated using Darcy’s Law (Table 7-9).

Darcy's Law may be expressed as.

$Q = KIA$

Where	Q	=	groundwater discharge rate
	K	=	hydraulic conductivity
	I	=	hydraulic gradient
	A	=	cross-sectional area

The values listed in Table 7-9 are reported as inflow rates per 100 lineal feet of mine openings oriented perpendicular to the groundwater flow direction. Calculations at individual locations are adjusted for the thickness of the saturated alluvium at that location. For all calculations in Table 7-9, a gradient of 0.10 has been used, which is considered a conservative estimate for the alluvial groundwater system in the vicinity of the planned Coal Hollow Mine workings. It is important to note that while values for saturated aquifer thickness and local hydraulic gradient in the alluvial groundwater system can be determined relatively precisely, hydraulic conductivity values determined from slug testing methods are generally considered as order-of-magnitude estimates. Consequently, the information from Table 7-9 should be used for general purposes only. The estimated groundwater inflow rates presented in Table 7-9 suggest that copious, unmanageable amounts of alluvial groundwater will likely not be encountered. It should be noted, however, that alluvial sediments located east of the C2 well cluster may contain coarser grained sediments similar to those intercepted in well Y-102. Special mining protocols will be employed (See Appendix 7-9) when mining in this area (pit15; see Section 728.333) to minimize the potential for interception of large groundwater inflows.

As described in Appendix 7-11, Table 7-9 has been updated to reflect the current pit mine-inflow conditions in the Pit #2 and adjacent areas.

As surface mining operations advance toward the alluvial groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A), the information in Table 7-9 suggests that groundwater inflow rates in this area will be modest, generally on the order of a few tens of gallons per minute or less per 100 lineal feet of mine opening. However, it should be noted that, as discussed above, if mine openings in this area were to intersect a substantial thickness of coarse-grained alluvial material that was in good hydraulic communication with the coarse-grained alluvial system located along the eastern margins of Sink Valley, substantially greater rates of groundwater inflow could occur. Based on the information in Tables 7-8 and 7-9, this is not considered likely.

As mining operations advance toward the alluvial groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A) and groundwater discharge from up-gradient alluvial groundwater systems occurs, there is the potential that discharge rates from alluvial springs in this area could be diminished. The magnitude of this potential impact will be largely dependent on the drainage rate and volume of groundwater that may be drained from the up-gradient alluvial groundwater system.

The potential for diminution of discharge from alluvial springs near proposed mining areas near the northwest ¼ of Section 29, T39S, R5W will be minimized because:

1) As mining progresses toward the groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (see Drawing 7-4, groundwater discharge area A), groundwater inflows into mine openings and discharge rates from the nearby alluvial springs will be closely monitored. If groundwater inflow rates into mine openings are excessive, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, and

2) Individual mine pits in the Coal Hollow Mine will remain open for short lengths of time, generally no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). Consequently, any potential impacts to spring discharge rates in the alluvial groundwater system in this area will likely be short-lived. Because the alluvial groundwater recharge areas are located well up-gradient of proposed mining areas (mountain-front recharge) and will not be impacted, recharge to the alluvial system should continue uninterrupted, it is anticipated that water levels in the artesian groundwater system should recover from any mining-related declines in hydraulic head subsequent to the completion of mining in the area.

Groundwater discharge from the springs in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A) do not contribute any measurable baseflow discharge to streams in the area. This conclusion is based on the lack of any baseflow discharge in streams down-gradient of this area in Sink Valley (see monitoring data for SW-6 and SW-9). Rather, most of this discharge is likely ultimately lost to evapotranspiration as the water migrates across the low-permeability, near-surface clayey sediments in Sink Valley. Consequently, the potential temporary diminution of discharge from alluvial springs in the northwest ¼ of Section 29, T39S, R5W would not result in appreciable adverse impacts to the surrounding hydrologic balance.

It is considered likely that the average hydraulic conductivity of the placed run-of-mine backfill material will be low. This is because of the pervasiveness of low-permeability, clay-rich materials in the mine overburden and the anisotropic nature of the placed fill material. Consequently, the potential for the migration of appreciable quantities of groundwater through the fill is considered low. Accordingly, the potential for impacts to subirrigation and soil moisture in the lands up-gradient of mining areas will be minimized by the placement of the low-permeability backfill.

The potential for short-term impacts to subirrigation and soil moisture in the lands up-gradient of proposed mining areas will be minimized through the implementation of the hydrology resource contingency plan described in Appendix 7-9.

The Coal Hollow Mine has designed a plan to divert upgradient alluvial groundwater through an alluvial groundwater interceptor drain system. This plan is designed to minimize the potential for the interception of alluvial groundwater in the mine pit areas and to protect alluvial groundwater quality. The details of this plan are described in the Coal Hollow Mine Alluvial Groundwater Management Plan, which is presented in Appendix 7-9.

If any Utah State appropriated water rights are impacted by mining and reclamation operations in 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 Section 727 above.

728.320 <u>Presence of acid-forming or toxic-forming materials</u>

Chemical information on the acid- and toxic-forming potential of earth materials naturally present in the proposed permit area are presented in Appendix 6-2. Chemical information on the low-sulfur Smirl coal seam proposed for mining is presented in 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 Coal Hollow Mine permit and adjacent area are generally not present.

Total selenium (with a 5 mg/kg laboratory lower detection limit) was not detected in any of the samples from the Coal Hollow Mine permit area. Water-extractable selenium concentrations were also generally low (see Section 728.332 below). 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 are moderately alkaline (UDOGM, 2007). Data in Appendix 6-2 likewise indicate moderately alkaline conditions in sediments in the permit area. The solubility of 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. Additionally, most of the materials that will be 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 is anticipated that groundwater seepage volumes through low-permeability backfill and reclaimed land surfaces in reclaimed mine pit areas and excess spoils storage areas will not be large. 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 overburden and underburden samples analyzed, with the neutralization potential commonly exceeding the acid potential by many times, suggesting that acid-mine-drainage will not be a concern at the Coal Hollow Mine (see Section 728.332 below for a further discussion) 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 (Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well aerated waters, and consequently excess iron is not anticipated 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.

Because of the overall low-permeability of the rock strata and sediments surrounding the mine workings (primarily the shales and claystones of the lower Tropic Shale), the potential for seepage of mine water outward into adjacent stratigraphic horizons is low. Additionally, because the floors of the mine pits need to be accessible in order to extract the coal, the mining operations will be carried out in such a manner that the accumulation of large amounts of water in the mine pits will be avoided.

728.331 <u>Sediment yield from the disturbed area.</u>

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. Four diversion ditches along with four 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.

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. 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 3h:1v slope and revegetated to minimize erosion.

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 (i.e. Lower Robinson Creek), 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 on 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 be minimized.

728.332 Impacts to important water quality parameters

As discussed above, appreciable quantities of groundwater are not anticipated to be intercepted in the Tropic Shale overlying proposed mining areas. Consequently, discharge of Tropic Shale groundwaters from mining areas is not anticipated. Because of the very low hydraulic conductivity of the marine Tropic Shale unit which immediately overlies the coal in proposed mining areas, the lateral migration of appreciable amounts of groundwater outward from proposed mine pit areas is not anticipated. Therefore, no impacts to important water quality parameters in surrounding groundwater and surface-water resources that could result from the interception of Tropic Shale groundwaters are anticipated.

Similarly, appreciable quantities of groundwater are not expected to emanate from the Dakota Formation in the mine floor into the 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), 2) appreciable natural discharge from the Dakota Formation in the surrounding area to springs or streams is not observed, supporting the conclusion that the natural flux of groundwater through the formation is meager, and 3) mining will commence near the truncated up-dip end of the formation, minimizing the potential for elevated hydraulic head in the Dakota Formation. The results of slug testing performed on wells screened in the Smirl coal seam indicate relatively low values of hydraulic conductivity for the coal seam (Table 7-8). In much of the proposed mining area, the coal seam is dry. Thus, large inflows of groundwater from the coal seam into mine workings are not anticipated. Likewise, the potential for seepage out of mine pits through the coal seam is minimal. Consequently, impacts to important water-quality parameters in the Dakota Formation potentially resulting from mining operations are not anticipated, nor are impacts to important water-quality parameters in surrounding groundwater and surface-water systems anticipated as a result of interactions with intercepted Dakota Formation groundwater.

The water quality of groundwaters in the alluvial groundwater system up-gradient of mining operations will likely not be impacted by mining and reclamation activities in the Coal Hollow Mine. Were alluvial groundwaters intercepted by mine openings allowed to flow into the mine pits, there would be the potential for substantially increased TDS concentrations as the water interacts with the marine Tropic Shale and the Smirl coal seam. This occurrence will be avoided.

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 (see Appendix 7-1). 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. Where possible, in the existing mine area and in the proposed North Private Lease, groundwater that will be encountered in alluvial sediments along the margins of mine pit areas will be routed through pipes, ditches or other conveyance methods away from mining areas via gravity drainage so as to prevent or minimize the potential for interaction with sediments disturbed by mining operations (including contact with the mined coal seam). If diverted alluvial groundwater were allowed to interact extensively with the Tropic Shale bedrock or Tropic Shale-derived alluvial sediments, similar increases in magnesium, sulfate, bicarbonate, and TDS concentrations would be anticipated. Consequently, where intercepted groundwaters will be routed around disturbed areas through pipes or well-constructed and maintained ditches, it is anticipated that detrimental impacts to important water quality parameters in these waters will be minimal.

The pumping and discharging of mine water from mine pits at the Coal Hollow Mine permit area is not anticipated. The impoundment of substantial quantities of water within the mine pits would likely result in degradation of groundwater quality and is also not compatible with the proposed surface mining technique (the coal extraction operations occur at the bottom of the mine pit and thus they cannot be performed in flooded mine pits). As discussed above, the only likely foreseeable source of appreciable quantities of groundwater is from the alluvial groundwater systems overlying the low-permeability Tropic Shale in proposed mining areas. Where this alluvial groundwater is encountered in mining areas, it will be diverted away from mine workings prior to significant interaction with sediments in disturbed areas. Any discharge from the mine pits that does occur will be regulated under a Utah UPDES discharge permit.

Acid mine drainage is not anticipated at the Coal Hollow Mine permit area. This is due primarily to the relatively low sulfur content of the coal (see Appendix 6-1; confidential binder) 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.

An analysis of the acid/base potential of samples collected from the overburden and underburden in the proposed mining area indicates that acid mine drainage will be unlikely to occur at the Coal Hollow Mine. The results of laboratory analysis of the acid/base potential of samples collected from the overburden, underburden, and Smirl coal zone are presented in Appendix 6-2. None of the overburden or underburden samples were acid forming, as each of the intervals sampled showed excess neutralization potential. Taken as a whole, the un-weighted composite average acid/base potential of the 57 overburden and underburden samples indicates a net neutralization potential of 174 tons per kiloton. The neutralization potential of the composite overburden/underburden (180 tons per kiloton) exceeds the acid potential (5.5 tons per kiloton) by more than 32 times. A general consensus opinion mentioned by the National Mine Land Reclamation Center (OSM, 1998) is that if the net acid/base potential exceeds 30 tons per kiloton, and the ratio of neutralization potential to acid potential exceeds two, then *alkaline* water will be generated and acid mine drainage will not occur. The acid/base characteristics of composite overburden and underburden in the Coal Hollow Mine area greatly exceed both of these two criteria, suggesting the strong likelihood that acid mine drainage will not be an issue at the Coal Hollow Mine.

Because of the net neutralization potential of the composite overburden/underburden in the Coal Hollow Mine area described above, the pH values of groundwater in fill areas will likely be neutral to alkaline. Accordingly, the solubility of dissolved trace metal species in the alkaline water will likely be low. Consequently, the potential for the mobilization and transport of trace metals in groundwater in the fill will likely also be low. Concentrations of total selenium, water extractable selenium, water extractable boron and other important chemical species in the overburden samples from the Coal Hollow Mine area are generally low. Water extractable selenium concentrations in the analyzed Dakota Formation underburden samples range from 0.05 to 0.2 mg/kg (see Appendix 6-2). Water extractable boron concentrations in the Dakota Formation underburden in a single location (CH-08; 6.5 mg/kg) marginally exceed the Division standard of 5 mg/kg. The limited quantities of material containing water extractable selenium and boron in these concentration ranges in backfill materials are not anticipated to result in appreciably elevated selenium or boron concentrations in groundwater or surface water supplies. Because the hydraulic conductivity of the composite run-of-mine backfill material (which will be rich with clays, silts, and shale) is expected to be low, the flux of groundwater that might migrate through the backfilled pit areas is likely to be low. Additionally, the reclaimed land surface will be graded to promote runoff of surface waters overlying backfilled areas, thus minimizing the potential for infiltration of surface waters into backfilled areas. Consequently, the potential for acid mine drainage or toxic drainage from backfilled areas to surrounding groundwater and surface-water supplies will be minimized.

As outlined in the topsoil and subsoil sampling plan in Chapter 2 of this MRP, materials with poor quality SAR, elevated selenium or boron concentrations, or poor pH as defined by Division guidelines will not be placed in the upper four feet of the reclaimed surface. These materials will also not be placed in the backfill within the top four feet of ephemeral drainages with 100 year flood plains, or in the top four feet in surface water impoundments, or in the top four feet in intermittent or perennial drainages including 100 year flood plains as outlined in the Division guidelines. Materials placed in the top four feet will be sampled to ensure that only suitable materials are placed in the top four feet of the reclaimed surface.

It is noteworthy that in the neighboring state of Wyoming, a water extractable selenium standard of 0.3 mg/kg is considered suitable for topsoil and topsoil substitutes, with concentrations ranging from 0.3 to 0.8 mg/kg being considered marginally suitable for topsoil and topsoil substitute.

As is typical with coal seams regionally, laboratory analyses of coal samples from the Coal Hollow Mine area indicates that there is a net acid forming potential in the coals of the Smirl coal zone (see Appendix 6-2). However, the mining plans call for the mining and removal of 95% of the total coal seam thickness from mining areas, leaving only minor amounts of coal in backfilled areas. Consequently, the potential contribution to the overall acid/base potential of the composite backfill material would be small. Assuming a worst-case-scenario – that all the coal would be retained in the backfill material – the calculated acid/base potential of the composite backfill material is still well within the limits suggested by OSM (1998) to indicate that alkaline discharge without acid mine drainage would be likely.

As described in Chapter 5, Section 532, surface runoff that occurs on disturbed areas will be treated through sedimentation ponds or other sediment-control devices and particulate matter will be allowed to settle prior to the discharging of the water to the receiving water, thus controlling suspended solids concentrations.

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 will be implemented that will help minimize any potential detrimental impacts to the environments.

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

Based on these findings, it is concluded that the potential for mining and reclamation activities in the Coal Hollow Mine permit area to cause detrimental impacts to important water quality parameters is minimal.

728.333 Flooding or streamflow alteration

As described above, appreciable groundwater inflow from the Tropic Shale and Dakota Formation into mine pits at the Coal Hollow Mine are not anticipated. Appreciable groundwater inflows are anticipated only from the relatively thin, overlying alluvial groundwater systems. The thicknesses of the alluvium adjacent to mine openings in the proposed mining areas is generally less than 40 to 50 feet. The hydraulic conductivities of the predominantly clayey and silty alluvial sediments are low, and consequently, very large or sudden groundwater inflows into mine openings are not anticipated. Where appreciable alluvial groundwater is encountered adjacent to mine openings, it will be routed away from mining areas through ditches or other conveyance mechanisms. Details of the Coal Hollow Mine Alluvial Groundwater Management Plan are provided in Appendix 7-9. Consequently, discharge of mine water from the mine pits is not anticipated. The rates of alluvial groundwater drainage that could occur will likely not be of a magnitude that could potentially cause flooding or streamflow alteration in either the Sink Valley Wash or Lower Robinson Creek drainages.

If excess groundwater were to be encountered during mining operations at the existing mine area or in the proposed North Private Lease such that it could not be adequately managed or discharged in compliance with the Utah UPDES discharge permit (which is considered unlikely), Alton Coal Development, LLC may when necessary construct supplemental containment and settlement ponds in which mine discharge waters may be held for treatment (where necessary) and subsequent discharge through UPDES discharge points in compliance with the UPDES discharge permit, minimizing the potential for flooding or streamflow alteration in areas adjacent to mining.

When coal mining near the eastern edge of the Coal Hollow Mine permit area occurs (mine pits 13-15), special measures will be taken to minimize the potential for the interception by the mine openings of large quantities of groundwater from artesian groundwater system in the northwest ¼ of Section 29, T5W, R39S, and to adequately deal with groundwater inflows if such occur. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

When mining operations advance toward the eastern edge of the permit boundary in pit 15, material excavating in the alluvial sediments will be performed incrementally and with caution. As excavation proceeds, if coarse, water-bearing alluvial sediments (gravels) are encountered, overburden removal in that area will be stopped. The excavation equipment operator will recover the exposed gravel zone with local impermeable sediments (abundant in the alluvium in the area) to halt groundwater inflow if possible. The hydrogeologist will be called to the site to access the hydrogeologic conditions. An investigation of the situation will be performed and a suitable work plan will be developed prior to the resumption of overburden removal in that area. The work plan will be designed to minimize the potential for intercepting unacceptably large inflows of groundwater into the mine pits. The work plan will most likely involve trenching in the alluvium in zones up-gradient of the mine pit area and the emplacement of a low-permeability cut-off wall. The cut-off wall would be emplaced in the excavated trench using acceptable native low-permeability materials. The cut-off wall would be designed to isolate the mine openings from the coarse-grained alluvial groundwater system sufficient to decrease mine inflows to acceptable levels (i.e. so as to minimize the potential for detrimental impacts to the hydrologic balance and to minimize the potential for flooding of mine pits or causing flooding or stream alteration).

As a temporary measure to manage any potential large groundwater inflows that may occur in these areas prior to the installation of a suitable up-gradient hydraulic barrier, the intercepted alluvial groundwaters would be routed along mine benches that “daylight” to the natural land surface in areas to the south. The water would be diverted into pond 4 which has an appreciable storage capacity and discharge structure.

It should be noted that the interception of moderate amounts of groundwater from shallow alluvial groundwater systems in these areas is considered likely. Modest inflows of shallow groundwater intercepted by the mine workings in these areas would be manageable and not of significant concern. The objective of the work plan would be to ensure that strong hydrodynamic communication between the coarse-grained artesian alluvial groundwater systems in the eastern portion of Sink Valley with the Coal Hollow Mine workings is not established.

The rate at which alluvial groundwater will be intercepted by the Coal Hollow Mine will be variable by location and time in permit area. Because of the heterogeneity inherent in most alluvial deposits, the quantifying of precise aquifer parameters in the various mining areas is not straightforward. Additionally, the geometry of the mine openings including the horizontal lengths and heights of mine pit faces adjacent to saturated groundwater systems that are exposed at any point in time are dynamic variables in the surface mining environment. Consequently, precise quantifications of mine groundwater interception rates are not readily obtainable. However, using the estimated mine pit groundwater inflow rates presented as discharge per linear foot of open pit in Table 7-9, it is considered likely that mine interception will be on the order of a few tens of gallons per minute in dry areas and at times when open pit sizes are small, to several hundred gallons per minute in wetter areas and at times when the open pit size is large. It is important to note that inflows into individual pit areas will be short lived, as the individual pits will commonly remain open for a few weeks to a few months.

The reasonably foreseeable maximum quantity of water that could be intercepted by the Coal Hollow Mine is largely a function of the manner in which coal mining operations are conducted in areas where the potential for encountering appreciable groundwater inflows is greatest. If large areas of water-bearing coarse-grained sediments were to be rapidly exposed in mine pit areas, large quantities of water would be anticipated (likely several thousands of gallons per minute). However, as described above, mining operations will be carried out in these areas using the special mining protocols described above. Consequently, large cross-sectional exposures of water-bearing coarse-grained alluvial sediments will not be allowed to be exposed to the mine pits and large inflows of groundwater on that magnitude are not anticipated.

In the unanticipated event that excessive quantities of water were to flow into the mine pits by any mechanism, the water would be pumped from the pits using a suitable pump and piping equipment that will be located on-site at the Coal Hollow Mine for such a contingency. Such water would be managed appropriately as required by all applicable State and Federal regulations. It should be noted that it is not in the mine's interest to allow excessive water to flow into the mine pits. All reasonable efforts will be taken to minimize the potential for flooding of the mine pits (an event that is not considered reasonably foreseeable or probable to occur).

Through the implementation of the above described mining protocols in areas where potentially large groundwater inflows could reasonably be anticipated to occur, the potential for the interception of large quantities of water by the mine is minimized. Consequently, the potential for flooding or streamflow alteration that could occur as a result of intercepting and discharging large quantities of water will be minimized and is considered unlikely.

The principal surface-water drainages in and adjacent to the Coal Hollow Mine permit area are in many locations not stable in their current configurations (see photograph section). Currently, these stream drainages are actively eroding their channels during precipitation events, resulting in down-cutting and entrenchment of stream channels, the formation of unstable near-vertical erosional escarpments adjacent to stream channels (which occasionally spall off into the stream channel), aggressive headward erosion of stream channels and side tributaries, and the transport of large quantities of sediment associated with torrential precipitation events. These processes are currently actively ongoing in the proposed permit and adjacent area and the upper extents of these erosional processes are in many locations migrating upward in stream channels, resulting in increasing lengths of unstable stream channels.

Hereford (2002) suggests that the valley fill alluviation in the southern Colorado Plateau occurred during a long-term decrease in the frequency of large, destructive floods, which ended in about 1880 with the beginning of the historic arroyo cutting. Hereford (2002) further suggests that the shift from deposition to valley entrenchment coincided with the beginning of an episode of the largest floods in the preceding 400-500 years, which was probably caused by an increased recurrence and intensity of flood-producing El Nino Southern Oscillation events beginning at ca. A.D. 1870.

The exact causes of the entrenchment of stream channels and the creation of the numerous arroyos currently in existence in the southwestern United States are not completely understood. Vogt (2008) suggests that three primary factors resulted in the arroyo formation. These factors included 1) changes in climate that produced heavy rainfall, 2) land-use practices such as livestock grazing, and 3) natural cycles of erosion and deposition caused by internal adjustments to the channel system. The temporal coincidence of the causes may have magnified the effect of each factor.

Each of these factors likely contributed to the formation of the entrenched stream drainages and arroyos in the Coal Hollow Project area. Gregory (1917) states that historical evidence indicates that the cutting of Kanab Creek began when a large storm occurred on 29 July 1883, and that unusually large amounts of precipitation were received in 1884-85. In this period the Kanab Creek channel was down-cut by 60 feet and widened by 70 feet for a distance of about 15 miles. The lowering of Kanab Creek may have resulted in a lowering of the local base level and consequent incision of both Sink Valley Wash and Lower Robinson Creek. As suggested by Vogt (2008), other factors, such as the heavy livestock grazing in the local area, which was occurring contemporaneously with the heavy thunderstorm events, likely also contributed to the overall conditions that brought about the stream down-cutting episode in the late 1800s.

While the precise sequence of events and conditions that triggered the arroyo formation and stream entrenchment in the principle surface drainages in and adjacent to the Coal Hollow Project area is not known, it is readily apparent that the principle surface water drainages are not currently in a condition of equilibrium. Stream head-cutting (headward erosion), bank erosion, and spalling of the steep stream channel walls are ongoing processes in the Coal Hollow Project area.

The mining and reclamation plan for the Coal Hollow Mines has been designed to minimize the potential for sediment yield and erosion in the mine permit areas. Accordingly, the mining and reclamation plan minimizes the potential for stream channel erosion and instability within the permit area. No mining-related activities are planned that would likely result in a worsening of the current instability of the surface water drainages in the permit and adjacent area.

The Coal Hollow Mine mining and reclamation plan calls for reclamation activities concurrent with mining progression, which results in the smallest disturbed area footprint and minimizes the length of time that the land surface is susceptible to erosion. The plan also calls for soil tackifiers to be used as a temporary soil stabilizer on reclamation areas prior to seeding. Seeded areas will be mulched. Vegetation established in final reclamation areas will minimize the potential for sediment yield and stream erosion in the long term.

The potential for erosion on the planned excess spoils pile will likewise be minimized. The design plans for the excess spoils pile call for the side slopes exceeding 60 feet in height to be constructed with concave slopes to promote slope stability and to minimize the erosion potential. The excess spoils pile will also be revegetated to minimize the erosion potential.

The Lower Robinson Creek reconstruction will likewise be constructed to promote stability and resistance to erosion. Details of the Lower Robinson Creek reconstruction are shown on Drawings 5-20A and 5-21A. The construction of the channel will include riprap of the channel bottom and the inclusion of an inner flood plane to minimize erosion during flooding events. The stream channel will be revegetated to minimize erosion potential. The Lower Robinson Creek reconstruction is designed to leave the drainage in a condition at final bond release that is at least as stable as the current pre-mining condition.

Following reclamation, stream channels will be returned to a stable state to the extent possible given the currently unstable state of natural drainage channels in the area. Stream channels will be designed to withstand anticipated storm events, thus minimizing the potential of flooding in the reclaimed areas.

The overall condition of the land surface and the surface-water drainages within the permit area at final bond release will likely meet or exceed the current pre-mining conditions. However, it should be noted that Alton Coal Development, LLC will have no control over the land management practices and landowner activities that may be implemented on the privately owned lands of the reclaimed Coal Hollow Mine area after final bond release. Accordingly, the degree of erosional stability and overall conditions in the reclaimed lands and stream drainages in the post bond-release period is not in the control of Alton Coal Development, LLC.

The existing principle surface-water drainages adjacent to the Coal Hollow Mine permit area have large discharge capacities (lower Sink Valley Wash below the County Road 136 crossing, Lower Robinson Creek, and Kanab Creek). These drainages periodically convey large amounts of precipitation runoff water associated with torrential precipitation events. The anticipated discharge rates from alluvial groundwater drainage and the maximum reasonably foreseeable amount of mine discharge water that could potentially be required to be discharged from mine pits is much less than that periodically occurring during major torrential precipitation events. The addition of modest amounts of sediment-free water into these stream channels has the potential to cause minor increases in channel erosion. However, the magnitude of this potential impact will likely be small relative to that occurring during torrential precipitation events.

Most precipitation waters falling on disturbed areas will be contained in diversion ditches and routed to sediment impoundments that are designed to impound seasonal water and storms. Sediment control facilities will be designed and constructed to be geotechnically stable. This will minimize the potential for breaches of sediment control structures, which if they occur could result in down-stream flooding and increases in stream erosion and sediment yield. Emergency spillways will be part of the impoundment structures to provide a non-destructive discharge route should capacities ever be exceeded.

Details associated with these structures at the existing Coal Hollow can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2, the structures at the North Private Lease can be viewed on Drawing 5-67 through 5-71 and Appendix 5-12.

It should be noted that during the startup and construction phase of the mine operation, while the ditches and sediment control ponds are being constructed, temporary silt control measures will be utilized. These measures may include the use of silt fences or other appropriate sediment control measures as necessary.

As shown on Drawing 5-26 for the Coal Hollow Mine, there are two sediment impound watershed areas within the mine permit area (Watershed 5 and Watershed 6) from which precipitation runoff water will not be routed through sediment ponds.

Watershed 5 area includes 28 acres near the Sink Valley Wash/Lower Robinson Creek drainage divide. The land surface in Watershed 5 is relatively flat, sloping at about a one percent grade. Because of the flatness of the land surface in Watershed 5, it is not practical to construct ditches to convey water from this area to a sediment pond. Consequently, control of sediment in runoff water from Watershed 5 will be accomplished through the use of a silt fence or other appropriate sediment control measure placed along the western permit boundary adjacent to Watershed 5 (see Drawing 5-26). Precipitation water falling on Watershed 5 will be retained as soil moisture, retained in the lowest portions of the watershed and allowed to evaporate or infiltrate or, after treatment with silt fences or other appropriate sediment control measures, allowed to flow down gradient onto lower lying adjacent areas.

Watershed 6 includes 19 acres located within the permit boundary east of the proposed Lower Robinson Creek reconstruction (see Drawing 5-26). The land surface in this area slopes gently toward the west at an approximately three to four percent grade. The Watershed 6 area will be isolated from a sediment pond by the reconstructed Lower Robinson Creek stream channel. Control of sediment in Watershed 6 will be accomplished through the installation of a silt fence or other appropriate sediment control measure along the margin of the watershed as shown on Drawing 5-26. The soils on the post-mining land surface in Watershed 6 will initially be stabilized with the use of tackifiers. Subsequent revegetation of the land surface in Watershed 6 will minimize the potential for erosion. After treatment with silt fences or other appropriate sediment control measures, precipitation water falling on Watershed 6 will be allowed to flow down-gradient toward adjacent lands or toward the Lower Robinson Creek stream channel.

The potential for flooding or streamflow alteration resulting from mining and reclamation activities at the Coal Hollow Mine permit area is considered minimal.

728.334 <u>Groundwater and surface water availability</u>

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. The areas of groundwater use in the Coal Hollow Mine permit and adjacent area are located in the northwest ¼ of Section 29, T39S, R5W (see Drawing 7-4; groundwater discharge area A), and in the northwest ¼ of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). The likely future availability of groundwater in each of these areas is discussed below.

<u>Groundwater discharge area A (Northwest ¼, Section 29, T39S, R5W)</u>

Groundwater use in area A occurs from several alluvial springs and seeps that are used for stock watering and limited domestic use. As described in Section 728.311 above, short-term diminution in discharge rates from springs in northwest ¼ of Section 29, T39S, R5W are possible as mining operations advance toward these springs. This potential impact is associated with the possible drainage of up-gradient alluvial groundwater into mine openings as mining advances toward groundwater discharge area A. Because individual mine pits will typically remain open for less than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled) before subsequently being backfilled and reclaimed, the potential for long-term drainage of alluvial groundwater into the mine voids is negligible, and thus any potential decreases in alluvial discharge in groundwater discharge area A is anticipated to be short-lived.

If groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities. Consequently, the potential that groundwater could become unavailable in this area is minimal. Additionally, if alluvial groundwater resources were to become unavailable in this area due to mining and reclamation activities in the Coal Hollow Mine permit area, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

It should be noted that the proposed water replacement source is a new well that will produce groundwater from the coarse-grained alluvial groundwater system in Sink Valley. Nearby springs that could potentially be impacted by mining and reclamation activities are supported by the same alluvial groundwater system. However, while modest decreases in the artesian hydraulic pressures in the alluvial groundwater system could potentially result in diminution of spring flows, the new well will be equipped with an electric well pump providing the capability to produce groundwater from the alluvial system even if the hydraulic head in the alluvial groundwater system were to be diminished such that artesian flow conditions temporarily ceased to exist.

<u>Groundwater discharge area B (Northwest ¼, Section 32, T39S, R5W)</u>

Groundwater use in groundwater discharge area B occurs at alluvial springs and seeps located southeast of the Coal Hollow Mine permit area that are used for stock watering and limited domestic use. As described in Section 728.311 above, although some temporary and short-lived diminution in discharge rates from springs in northwest ¼ of Section 29, T39S, R5W is possible, this potential impact is not considered likely.

In the event that alluvial groundwater resources were to become unavailable in this area due to mining and reclamation activities in the Coal Hollow Mine permit area, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above.

Surface-water availability

Surface-water use in the Coal Hollow Mine permit and adjacent area occurs in the Sink Valley Wash drainage and in Lower Robinson Creek. Surface waters in the Sink Valley Wash drainage (primarily from Water Canyon via an irrigation diversion and from Swapp Hollow; appreciable discharge in Sink Valley Wash below Section 29 T39S, R5W is usually absent) are utilized for both stock watering and limited irrigation use. Stream water in the Sink Valley Wash drainage is derived from runoff from the adjacent Paunsaugunt Plateau area. Because the surface water in the drainage originates from areas up-gradient areas located large distances from proposed mining areas, and because the stream channel is entirely outside the permit area and will not be impacted by mining and reclamation activities, there is essentially no probability that surface water availability in the Sink Valley Wash drainage could become unavailable as a result of mining and reclamation activities.

Discharge in Lower Robinson Creek immediately above the Coal Hollow Mine permit area typically occurs only in direct response to significant precipitation or snowmelt events. Thus, surface-water availability is currently limited in this drainage prior to any mining activities.

Seepage of alluvial groundwater into the deeply incised lower Robinson Creek stream channel occurs near the contact with the underlying Dakota Formation in the southeast quarter of Section 19, T39S, R5W. This water is likely related to saturated alluvial deposits directly underlying the Robinson Creek stream channel and emerges near where the stream channel intersects the alluvial groundwater system. This seepage of alluvial water is usually about 5 - 10 gpm or less and is routinely monitored at monitoring station SW-5 (Drawing 7-2).

It should be noted that the Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

The information presented above suggests that the potential for significant impacts to groundwater and surface-water availability resulting from mining and reclamation activities in the Coal Hollow Mine permit and adjacent systems in the region is low.

728.340 <u>Whether mining and reclamation activity will result in contamination, diminution or interruption of State-appropriated waters</u>

State appropriated water rights in the Coal Hollow Mine permit and adjacent area are shown on Drawing 7-3 and tabulated in Appendix 7-3.

Appropriated groundwaters include alluvial springs and seeps in the northwest ¼ of Section 29, T39S, R5W (groundwater discharge area A), springs and seeps in the northwest ¼ of Section 32, T39S, R5W (groundwater discharge area B). State appropriated surface waters include reaches of Sink Valley Wash east of the Coal Hollow Mine permit area, and reaches of Lower Robinson Creek.

The potential for mining and reclamation activities at the Coal Hollow Mine permit area to result in contamination, diminution or interruption of State-appropriated water in the Coal Hollow Permit and adjacent area are described in detail in Sections 728.310, 728.320, 728.332, and 728.334.

With the possible exception of short-term diminution in discharge rates from springs and seeps in the northwest ¼ of Section 29, T39S, R5W, Contamination, diminution, or interruption of State-appropriated waters in the Coal Hollow Mine permit and adjacent area are not anticipated. It should be noted that if groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, minimizing the potential for diminution of discharge rates from these springs.

Additionally, it should be noted that the Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

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, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above.

730 OPERATION PLAN

Coal mining in the Coal Hollow Mine permit area will occur using surface and underground mining techniques. Planned coal mining operations in the North Private Lease area will be conducted using conventional pit surface mining and highwall mining techniques. All coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. Operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

In order to maximize the use and conservation of the coal resource, coal will be recovered using a combination of large hydraulic backhoes or front end loaders and off-road trucks, highwall mining and underground mining equipment. Mined coal will be hauled to a central coal processing area for crushing and placement into a stockpile. Coal from the stockpile will be transferred into a bin and loaded into over the road trucks for transport.

The plan, with Drawings, cross sections, narrative, descriptions, and calculations indicates how the relevant requirements will be met. The lands subject to coal mining and reclamation operations over the estimated life of the operations are identified and briefly described. All appropriate information is located in the subsequent sections and Drawings 5-1 through 5-39 and Appendices A5-1 through A5-3.

731 GENERAL REQUIREMENTS

Operations will be conducted to assure protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

Groundwater and Surface-Water Protection

To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acid, toxic, or other harmful infiltration to the groundwater system. Additionally, excavations, and disturbances will be managed to prevent or control discharges of pollutants to the groundwater.

Products including chemicals, fuels, and oils used in the mining process will be stored and used in a manner that minimizes the potential for these products entering groundwater systems. Concrete oil and fuel containments will be constructed as shown on Drawings 5-3 and 5-8.

A facilities spill plan for the Coal Hollow Mine is provided in Appendix 7-5. When operations begin, there will be an EPA SPCC plan available on site for inspection.

The wash bay sump sludge will be removed as necessary and transported off site to an approved hazardous waste disposal facility.

The wash bay at the mine site will include a closed circuit water recycle system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment, thus minimizing water consumption the potential for contamination of groundwater resources. Details for this structure can be viewed on Drawings 5-3, and 5-8.

As mining operations approach springs and seeps in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A), there is the potential for drainage of up-gradient into mine openings to cause short-lived diminution of discharge from these springs. If groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, minimizing the potential for diminution of discharge rates from these springs. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

The mine will replace loss of water identified for protection in this MRP that are impacted by mining and reclamation operations.

To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acidic or toxic drainage, prevents to the extent possible, additional contributions of suspended solids to streamflow outside the permit area and otherwise prevents water pollution. Runoff and sediment control measures are described in detail in Chapter 5 of this MRP. The mine will maintain adequate runoff- and sediment-control facilities to protect local surface waters.

Discharge of mine water that has been disturbed by coal mining and reclamation operations is not anticipated. However, any discharges of water from areas disturbed by coal mining and reclamation operations that do occur will be made in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR part 434. Discharge of mine waters will be regulated by a Utah UPDES discharge permit.

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 straw bales will be utilized to control sediment discharge from the permit area.

In order to accomplish these objectives for the Coal Hollow Mine, 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. In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760. Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763. Storm water and snow melt that occurs within the facilities area will be routed to an impoundment that will contain sediment. This impoundment will have a drop-pipe spillway installed that will allow removal of any oil sheens that may result from parking lots or maintenance activities by using absorbent materials to remove the sheen. Details for this impoundment can be viewed on Drawings 5-28.

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.

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.

In order to accomplish these objectives for the North Private Lease, 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, fifteen diversion ditches. The locations of these structures can be viewed on Drawing 5-65. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-67 through 5-71. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-11. The watershed and structure sizing analysis can be viewed in Appendix 5-12. In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760. Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763.

Fifteen diversion ditches along with 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 5-12. The structures will have sediment removed as necessary to ensure the required capacities. Details for these structures can be viewed on Drawings 5-65 through 5-71. Calculations and supporting text can be viewed in Appendix 5-12.

As shown on Drawing 5-64 for the North Private Lease, there is one watershed areas within the mine permit area (ASCA-1) from which precipitation runoff water will not be routed through sediment ponds.

ASCA-1 area includes 3.1acres of access road to the North Private Lease that will not flow to a sediment impoundment. Consequently, control of sediment in runoff water from ASCA-1 will be accomplished by routing runoff from the road to a row of straw bales for treatment. These straw bales surround a drop box to a culvert flowing under the road (see Appendix 5-13).

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.

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

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 will be implemented that will help minimize any potential detrimental impacts to the environments.

Products including potentially hazardous chemicals, fuels, and oils used in the mining process will be stored and used in a manner that minimizes the potential for these products to contaminate surface-water resources. Concrete oil and fuel containments will be constructed as shown on Drawings 5-3 and 5-8.

The wash bay at the mine site will include a closed circuit water recycle system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment, thus minimizing water consumption the potential for contamination of surface-water resources. Details for this structure can be viewed on Drawings 5-3, 5-8, and Appendix 5-4. .

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to R645-301-732.400, R645-301-742.400 and R645-301-762. The specific plan for road locations and design are presented in R645-301-534. The location and details for roads can be viewed on Drawings 5-3 and 5-22 through 5-24 for the Coal Hollow Mine and on Drawings 5-47 and 5-58 through 5-64 for the North Private Lease.

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed to control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area; Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751; minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems; and refrain from significantly altering the normal flow of water in streambeds or drainage channels. No acid- or toxic-forming substances will be used in road surfacing.

All roads for the Coal Hollow Mine will be removed and reclaimed according to Drawings 5-37 and 5-37A. The estimated timetable for removing these roads is shown on Drawing 5-38. All roads for the North Private Lease will be removed and reclaimed according to Drawings 5-74 and 5-75. The estimated timetable for removing these roads is shown on Drawing 5-76. 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 (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles.

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

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.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

The locations of wells that are planned to be removed by intercepting mining operations in the North Private Lease are shown on Figure 20 of Appendix 7-16. Monitoring wells to be removed by mining operations in the North Private Lease that are deeper than the depths of the advancing mine working will be plugged and abandoned prior to their interception by the mining operations. Shallow monitoring wells that will be completely excavated by mine disturbance will not be plugged/abandoned because the entire well/borehole length will be removed by mining operations and thus plugging and abandoning these wells serves no purpose.

The six monitoring wells that are planned to be removed by mining operations are not planned to be replaced. Monitoring of the alluvial groundwater system within the North

Private Lease after mining is completed will be accomplished using the monitoring wells that are not planned to be intercepted by mining (see Figure 20 of Appendix 7-16) and also using additional monitoring wells proposed for construction in the North Private Lease. As directed by the Division, ACD has proposed the construction of up to 30 additional alluvial monitoring wells in locations within and adjacent to the North Private Lease that are to remain after mining is complete. Monitoring of alluvial groundwater quantity and quality can be accomplished using these wells.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

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.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731 and be managed according to the following.

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

If mining and reclamation activities result in the contamination, diminution, or interruption of State appropriated groundwater or surface-water sources, replacement water will be provided using the alternate water source described in R645-301-727.

Seasonal baseline water monitoring information for all water rights that could be affected by mining in the permit and adjacent area have been submitted electronically to the Division's on-line hydrology database.

731.200 Water Monitoring

This section describes the hydrologic monitoring plan (including that for the 85.88-acre Dame Lease IBC). The hydrologic monitoring plans for groundwaters and surface waters in the proposed North Private Lease area are provided in Appendix 7-16 and Appendix 7-18. Locations of surface-water and groundwater monitoring sites are indicated on Drawing 7-10. Hydrologic monitoring protocols, sampling frequencies, and sampling sites are described in Table 7-4. Groundwater and surface-water monitoring locations are listed in Table 7-5. Operational field and laboratory hydrologic monitoring parameters for surface water are listed in Table 7-6, and for groundwater in Table 7-7. The hydrologic monitoring plan during reclamation will be the same as during the operational phase. The hydrologic monitoring parameters have been selected in consultation with the Division's directive Tech-006, *Water Monitoring Programs for Coal Mines.*

The groundwater and surface-water monitoring plan is extensive and includes more than 50 monitoring sites. The monitoring plan is designed to monitor groundwater and surface-water resources for any potential impacts that could potentially occur as a result of mining and reclamation activities in the Coal Hollow Mine permit and adjacent area. Each of the sampling locations and their monitoring purpose are described below.

Streams

Kanab Creek will be monitored at sites SW-3 (above the permit area), and SW-2 (below the permit area). Lower Robinson Creek will be monitored at sites SW-4 (above the permit area), SW-101 (within the permit area), and SW-5 (below the permit area above the confluence with Kanab Creek). The irrigation water near SW-4 will also be monitored at site RID-1. Swapp Hollow creek will be monitored above the permit area at site SW-8. Sink Valley Wash will be monitored at SW-6 (a small tributary to the wash immediately below the permit area) and at SW-9, located in the main drainage below the permit area. All of these locations, with the exception of RID-1) will be monitored for discharge and water quality parameters specified in Table 7-6 quarterly, when reasonably accessible. Additionally, Lower Robinson Creek will be monitored at site BLM-1, which is near the location of alluvial groundwater emergence in the bottom of the stream channel. RID-1 will be monitored for discharge and field water quality parameters. BLM-1 will be monitored for discharge and water quality parameters specified in Table 7-6 quarterly. Monitoring sites BLM-1, SW-5, SW-6, and SW-9 will also be monitored for total and dissolved selenium quarterly.

Springs

Eight springs from alluvial groundwater area A will be monitored including SP-8, SP-14, SP-16, SP-19, SP-20, SP-22, SP-24 and Sorensen Spring. Spring SP-8 is a developed spring in area A that provides culinary water for the Swapp Ranch house. SP-8 will be monitored for discharge and operational laboratory water quality measurements quarterly when reasonably accessible. Springs SP-14, SP-16, SP-19, SP-20, SP-22, SP-24 and Sorensen Spring springs will be monitored for discharge and field water quality measurements quarterly when reasonably accessible.

Springs SP-4 and SP-6, and SP-33, which are located in Sink Valley below the proposed mining area, will also be monitored. SP-6 is an area of diffuse seepage above an earthen impoundment in the wash immediately below the permit area. Spring SP-33 is a developed spring that discharges into a pond below the permit area and provides culinary water to two adjacent cabins. Each of these Springs SP-6 and SP-33 will be monitored for discharge and operational laboratory water quality measurements quarterly when reasonably accessible. SP-4 discharges from a fault/fracture system in the Dakota Formation near the canyon margin in Sink Valley Wash below the permit area. Spring SP-4 will be monitored for discharge and field water quality measurements quarterly when reasonably accessible. Spring SP-3 discharges from pediment alluvium in the upland area above Sink Valley Wash more than a mile from the permit area. It is extremely unlikely that discharge rates or water quality at this spring could be impacted as a result of mining-related activities in the mine permit area. However, this spring will be monitored for discharge and field water quality measurements quarterly, primarily to provide background data from springs in the region.

<u>Wells</u>

Wells Y-98 (Robinson Creek alluvium above the permit area), Y-45 (coal seam well in Swapp Hollow above permit area), Y-102 (flowing alluvial well in alluvial groundwater discharge area A), Y-36 (coal seam well in Sink Valley above the permit area), Y-38 (coal seam well in Sink Valley permit area), Y-61 (alluvial well at the Sorenson Ranch), and C5-130 (new monitoring well in alluvial groundwater discharge A) will be monitored quarterly when reasonable accessible. Well Y-61 will be monitored for groundwater operational laboratory water quality parameters to monitor groundwater quality in alluvial groundwater discharge area A. The other wells will be monitored for water level only.

Additionally, 19 newly constructed monitoring wells constructed in the Sink Valley alluvial groundwater system will be monitored quarterly. These include C2-15, C2-28, C2-40, C3-15, C3-30, C3-40, C4-15, C4-30, C4-50, C7-20, C9-15, C9-25, C9-40, LS-28, LS-60, LS-85, SS-15, SS-30, and SS-75. All of these wells will be monitored quarterly for water level. Additionally, wells LS-85 and SS-30 will be monitored for groundwater operational laboratory water quality measurements.

Additionally two wells in the Lower Robinson Creek alluvium will be monitored for water level and groundwater operational laboratory chemistry. These include UR-70 located above proposed mining locations in the Lower Robinson Creek drainage, and LR-

45, located below proposed mining areas adjacent to Lower Robinson Creek. It should be noted that LR-45 is located near a proposed sediment pond impoundment. Consequently, if this well becomes unsuitable for monitoring, an alternate location will be used to monitor the Lower Robinson alluvial groundwater system in this area.

Wells C0-18 and C0-54 are located near the initial proposed mining areas in the Lower Robinson Creek drainage. These will be monitored for water level quarterly.

It should be noted that many of the wells specified for monitoring in this monitoring plan will at some point be destroyed or rendered inoperable as the mine workings precede through the area. These wells will be monitored until such a time as they are destroyed or become inoperable.

The possible need for an additional monitoring well located along the east-west permit boundary in Section 30, T39S, R4W has been evaluated. As described in Section 728.332, based on the laboratory analyses of acid and toxic forming materials in the overburden, coal seam, and underburden, it has been determined that discharges from the mine areas will likely be alkaline in character and acid mine drainage will likely not occur. Similarly, the potential for toxic drainage is not anticipated (see Section 728.332). Additionally, given the general east to northeasterly direction of the bedrock dip in the mine area, groundwater migrating through the pit backfill areas after mining will likely migrate down slope in those same directions (to the east). Because the lower portions of the highwalls surrounding the mine pit areas consist of relatively impermeable Tropic Shale bedrock, the potential for migration of appreciable quantities of groundwater from the mine pit fill areas into surrounding unmined areas is low (see Section 728.320). Shallow alluvial groundwater that could potentially migrate to the west is monitored for laboratory water quality parameters at well LR-45. Surface runoff from these areas is monitored for laboratory water quality parameters at site SW-5, which is located in Lower Robinson Creek below the proposed mining areas. For these reasons, the installation and monitoring of an additional monitoring well is not deemed necessary at this time.

Groundwater and surface-water monitoring will continue through the post-mining periods until bond release. The monitoring requirements, including monitoring sites, analytical parameters and the sampling frequency may be modified in the future in consultation with the Division if the data demonstrate that such a modification is warranted.

85.88-acre Dame Lease IBC

In conjunction with highwall mining activities within the 85.88-acre Dame Lease IBC, supplemental water monitoring activities will be performed at selected nearby springs and wells. This will include weekly monitoring of spring discharge rates at sites SP-8, SP-14, SP-20, SP-22, and SP-40, and weekly measurements of water levels in monitoring wells C4, C2, C3, C5, and Y-61. The weekly monitoring at these sites will begin one month prior to the commencement of highwall mining in the 85.88-acre Dame Lease IBC and will continue until one month after highwall mining in the IBC is concluded.

Following the period of weekly monitoring, the above specified stations will be monitored monthly for a period of six months. The flow and water level data generated during this period of accelerated monitoring will be sent to the Division of Oil, Gas and Mining as a spreadsheet via e-mail at the end of each month.

In accordance with R645-302.245.230 all holes discharging water will be sealed within 72 hours after completion with impervious and noncombustible material. However, in the approved Ground Control Plan for CHM, MSHA requires the adjacent hole remain open for monitoring of the web. Thus, if an adjacent hole is discharging water and needs to be kept open for web monitoring then the discharge will be tested to determine if it contains acid or toxic-forming material and approval to keep this hole open for web monitoring will be requested from the Division in accordance with R645-302.245.230.

In order to verify that the highwall mining holes excavated into the 85.88-acre Dame Lease IBC do not cause depletion of the overlying shallow alluvial groundwater systems, the groundwater discharge rate (if any) that occurs from the mouths of the holes within the Dame Lease IBC will be monitored daily. The daily monitoring will commence upon completion of the hole excavation and continue until the hole is sealed. Where it is reasonably possible to do so, the discharge rate measurements will be performed using an appropriate field flow measurement technique (i.e. pipe and a calibrated container, flume, weir, etc.). In areas where the performance of a field discharge measurement is not reasonably possible (i.e. under diffuse seepage conditions or where unconcentrated dispersed flow conditions exist) the discharge rate will be estimated. Discharge rate measurements from the highwall holes will not be performed in areas where such measurements cannot be performed safely. In those areas where the discharge rates cannot safely be measured, this will be noted in the flow record and, where possible, a visual estimate of the discharge rate will be made. Upon approval from the Division, at times when no discharge is occurring from any of the open highwall mining holes in the Dame Lease IBC, discharge measurements will be performed daily on those days that the mine is operating (generally Monday through Friday). Under conditions where measurable flows are present at any open highwall mining hole in the 85.88-acre Dame Lease IBC, the flow measurements will be performed on a continuous daily basis (7 days a week) until the hole is sealed. The flow data for each hole will be sent to the Division as a spreadsheet via e-mail at the end of each month.

The details of the hydrologic monitoring plan for the North Private Lease area are provided in Appendix 7-16 and are summarized in Tables 7-4, 7-5, 7-6 and 7-7. The locations of surface-water and groundwater monitoring sites in the North Private Lease are shown in Appendix 7-16.

Instruction for the use of the groundwater and surface-water monitoring plans

The hydrologic monitoring plans for groundwaters and surface-waters at the Coal Hollow Mine (including the North Private Lease area) may be used to detect potential impacts to groundwater and surface-water systems that could occur as a result of the proposed operations. Prior to the performance of coal mining and reclamation activities at the mine, baseline monitoring of groundwater and surface-water resources was performed. This has included monitoring water quantity (stream and spring discharge rates and water levels in wells), and water quality (both field and laboratory water quality measurements). The monitoring data may be used by comparing the water quantity and water quality characteristics of groundwaters and surface-waters measured during the operational mining and post-mining periods with that measured during the baseline monitoring period for any parameter of interest to evaluate the nature and magnitude of any potential impacts (i.e. changes would be indicated by differences between the baseline data and the operational or reclamation phase data). In evaluating potential impacts, it is important that all potential factors which could potentially cause variability in water quantity and/or water quality characteristics be considered. These factors could include short-term or long-term variability in climatic conditions (which may conveniently be evaluated using the Palmer Hydrologic Drought Index as described in Appendix 7-1), changes in land use practices over time, or several other factors. A convenient way to evaluate the water quality characteristics and detect potential impacts to water quality of groundwaters and surface waters is through the use of Stiff diagrams (see Appendix 7-1 for further explanation). Information is also provided by the Utah Division of Oil, Gas and Mining regarding the use of Stiff diagrams (Utah.gov).

731.300. Acid- and Toxic-Forming Materials.

At the existing Coal Hollow Mine and the proposed North Private lease area, drainage from acid- and toxic-forming materials and underground development waste into surface water and ground water will be avoided by identifying and burying and/or treating, when necessary, materials which may adversely affect water quality, or be detrimental to vegetation or to public health and safety if not buried and/or treated.

Materials will be stored in a manner that will protect surface water and ground water by preventing erosion, the formation of polluted runoff and the infiltration of polluted water. Storage will be limited to the period until burial and/or treatment first become feasible, and so long as storage will not result in any risk of water pollution or other environmental damage.

Storage, burial or treatment practices will be consistent with other material handling and disposal provisions of R645 Rules.

During the period of operation of the Coal Hollow Mine, the observed pH of the water that has infrequently been discharged through the UPDES discharge points has consistently been alkaline in nature (UDOGM, 2015). No acid mine discharge has been observed at the Coal Hollow Mine. Measured concentrations of selenium and manganese in the mine discharge water have consistently been low (near the lower laboratory detection limits). Similarly, concentrations of total iron have also usually been low, although on a few occasions slightly elevated concentration of total iron (<1.61 mg/L) in the mine discharge water has been measured. These total iron concentrations are generally associated with suspended solids associated with storm water runoff or snowmelt events.

Based on the overall similarities in the geologic environments at the existing Coal Hollow Mine permit area and the proposed North Private lease area, it is considered likely that mine discharge waters that could potentially be discharged from the North Private Lease would have similar water quality characteristics (i.e. no acid mine drainage and no appreciable toxicity).

731.400. Transfer of Wells

Before final release of bond, exploratory or monitoring wells will be sealed in a safe and environmentally sound manner in accordance with R645-301-631, R645-301-738, and R645-301-765. With the prior approval of the Division, wells may be transferred to another party for further use. However, at a minimum, the conditions of such transfer will comply with Utah and local laws and the permittee will remain responsible for the proper management of the well until bond release in accordance with R645-301-529, R645-301-551, R645-301-631, R645-301-738, and R645-301-765.

731.530 State-appropriated water supply

A water supply well was constructed in the Sink Valley Alluvial groundwater system in October of 2010. The water well is being used as a water supply source for the mine and can also be used for water replacement if needed (also for use if needed as a replacement water source for mining in the 85.88-acre Dame Lease IBC).

731.600 Stream Buffer Zones

Any perennial or intermittent streams in the mine area will be protected by 100 foot stream buffer zones on either side of these streams. Coal mining and reclamation operations will not cause or contribute to the violation of applicable Utah or federal water standards and will not adversely affect the water quality and quantity or other environmental resources of the stream.

Temporary or permanent stream channel diversion will comply with R645-301-742-300. It should be noted that the Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

The areas surrounding the streams that are not to be disturbed will be designated as buffer zones, and will be marked as specified in R645-301-521.260.

731.700 Cross sections and Maps

The locations of springs and seeps identified in the Coal Hollow Mine permit and adjacent area are shown in Drawing 7-1. The locations of springs and seeps in the North

Private Lease area are shown in Appendix 7-16. The locations of baseline hydrologic monitoring locations (including those for the North Private Lease) are shown on Drawing 7-2. The locations of water rights in the Coal Hollow permit and adjacent area are provided on Drawing 7-3. Water rights in the North Private Lease area are shown on Drawing 7-3N. Cross-sections depicting the stratigraphy and hydrostratigraphy of the Coal Hollow Mine permit and adjacent area are presented in Chapter 6, Drawing 6-2 and in Appendix 7-16. Designs for impoundments in the Coal Hollow permit area are shown in Drawings 5-25 through 5-31 and impoundments in the North Private Lease area are shown in Drawings 5-65 through 5-67.

731.800 Water Rights and Replacement

Alton Coal Development, LLC commits to replace the water supply of an owner of interest in real property who obtains all or part of his or her supply of water for domestic, agricultural, industrial, or other legitimate use from the underground or surface source, where the water supply has been adversely impacted by contamination, diminution, or interruption proximately resulting from the surface mining activities. Baseline hydrologic information required in R645-301-624.100 through R645-301-624.200, R645-301-625, R645-301-626, R645-301-723 through R645-301-724.300, R645-301-724.500, R645-301-725 through R645-301-731, and R645-301-731.210 through R645-301-731.223 will be used to determine the extent of the impact of mining upon ground water and surface water.

Sorensen Spring (SP-40) is the current domestic water supply for the Sorensen Ranch (Personal communication, Darlynn Sorensen, 2008). There is currently no development at the spring that would convey water to the ranch house. Rather, water from the spring is obtained directly from the spring for use at the ranch. Monitoring of discharge rate and water quality is included in the proposed water monitoring plan for the Coal Hollow Mine. The operational and reclamation phase water monitoring protocols for this spring are listed in Tables 7-5 and 7-7A. Should the water source be interrupted, diminished, or contaminated, replacement water will be provided from the new water well that will be constructed prior to the beginning of overburden removal for pits 13, 14, and 15 (see description in section R645-301-727 above, and Drawing 5-8C) or other suitable water replacement source as approved by the Division.

There are no state-appropriated groundwater rights in the North Private Lease area.

As specified in R645-301-112, groundwater quantity will be protected by handling earth materials and runoff in a manner that will restore approximate premining recharge capacity of the reclaimed area as a whole, excluding coal mine waste disposal areas and fills, so as to allow the movement of water to the groundwater system.

732 Sediment Control Measures

Sediment control measures have been designed, constructed and maintained to prevent additional contributions of sediment to streamflow or to runoff outside the permit area.

732.100 Siltation Structures

Siltation structures within the permit area are described in Section 732.200

732.200 Sedimentation Ponds

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow 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.

Fifteen diversion ditches along with five sediment impoundments are proposed for the North Private Lease permit area. In addition, miscellaneous controls such as berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-47. Details associated with these structures can be viewed on Drawings 5-67 through 5-71 and Appendix 5-12.

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.

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

732.300 Diversions

The runoff control plan is designed to isolate, to the maximum degree possible, runoff from disturbed areas from that of undisturbed areas. Where possible, this has been accomplished by allowing up-stream runoff to bypass the disturbed area, and routing any runoff from undisturbed areas that enter the disturbed area into a sediment control system.

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow permit area. In addition, miscellaneous controls such as silt fence, berms and temporary diversion ditches 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. A segment of Diversion Ditch 4 (DD4), due to premining contours, was not constructed until fill from the spoils pile attained an elevation that allowed positive flow. Prior to disturbances and until the completion of DD4, a silt fence provided protection from offsite impacts. During reclamation, Pit 10 will be the final pit backfilled requiring the remaining spoil stockpiled to be relocated, thus DD4 will be relocated with the Pit 10 borrow operations. All borrow activity will occur south of DD4 until elevations south of DD4 cause a positive flow directly to Sedimentation Pond 3. At this time DD4 can be realigned allowing final removal of Pit 10 borrow material. All temporary ditches will meet the design requirements of Diversion Ditch 4 (designed for the 100-year, 24 hour storm) and will be adjusted within the permitted active mining area in relation to the active pit, currant spoils pile configuration and reclamation.

Fifteen diversion ditches along with five sediment impoundments are proposed for the North Private Lease permit area. In addition, miscellaneous controls such as silt fences, berms and temporary diversion ditches are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-63. Details associated with these structures can be viewed on Drawings 5-67 through 5-71 and Appendix 5-12.

732.400 Road Drainage

All roads will be constructed, maintained and reconstructed to comply with R645-301-742.400. Road drainage facilities include diversion ditches, culverts, containment berms, and/or water bars. Specific plans for road drainage, road construction, and road maintenance are presented in Chapter 5, Section 534 of this MRP.

A description of measures to be taken to obtain division approval for alteration or relocation of a natural drainage way will be presented to the Division when necessary.

A description of measures to be taken to protect the inlet end of a ditch relief culvert will be submitted to the Division when necessary.

All road drainage diversions will be maintained and repaired to operational condition following the occurrence of a large storm event. Culvert inlets and outlets will be kept clear of sediment and other debris.

733 IMPOUNDMENTS

733.100 General Plans

A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans for the Coal Hollow Mine have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2. The plans for the North Private Lease have been certified and a detailed geotechnical analysis has been provided in Appendix 5-11. The certifications, drawings and cross sections can be viewed in Drawings 5-67 through 5-71 and Appendices 5-12.

As requested by the Division, the design criteria of the mine site sediment ponds have been reevaluated in light of groundwater that is being encountered at the site (see Appendix 7-11). It was the determination of this reevaluation that the sediment ponds currently in place meet or exceed the minimum requirements of the Utah Coal Mining Rules and that the construction of additional ponds or the redesigning of existing ponds is not required at this time. Accordingly, the small ephemeral channel tributary to Lower Robinson Creek near the toe of the spoils pile mentioned in the Division Deficiency List (Task No. 3799) has been evaluated as a potential sediment pond site, but the construction of a sediment pond in that location is not required at the current time.

As indicated in Section 728.332, where appreciable alluvial groundwater inflows into the mine pit areas occur and where deemed necessary and possible, alluvial groundwater inflows into the mine pit areas will be diverted away from the mine pit areas through pipes, ditches, or other conveyance methods, minimizing the need for the pumping of mine discharge waters to the sediment ponds. Groundwater that interacts with the Tropic Shale and the Smirl coal seam in the mine pits is considered as mine water and accordingly it will be either routed to Pond #3 or Pond #4 in the Coal Hollow Permit and Pond #7 in the North Private Lease and subsequently discharged under the approved Coal Hollow Mine UPDES discharge permit, or it will be contained and managed within the pit areas and not discharged.

Depending on prevailing climatic conditions and on the nature and quantity of encountered mine waters, at times it may periodically be necessary to discharge water from the Coal Hollow Mine sediment ponds. The discharges from the ponds at the Coal Hollow Mine will occur in compliance with the approved Coal Hollow Mine UPDES permit (see Appendix 7-12).

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the Coal Hollow Mine. Each impoundment is designed to contain the run off from a 100 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-26. The following table summarizes the final capacity results for each impoundment:

Coal Hollow Mine 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 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 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 388 acres post mining; 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.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the North Private Lease. Each impoundment is designed to contain the run off from a 10 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-65. The following table summarizes the final capacity results for each impoundment:

North Private Lease Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

Structure 5 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18” primary spillway with an oil skimmer and an open channel secondary spillway that will have 6” D50 rip-rap. 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 18.8 acres. The cleanout and spillway elevation are 6840’ and 6848’ respectively. The top of the embankment is at elevation 6850’. Details for the design can be viewed on Drawing 5-67.

Structure 6 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18” primary spillway with an oil skimmer and an open channel secondary spillway that will have 6” D50 rip-rap. 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 24.0 acres. The cleanout and spillway elevation are 6858' and 6866' respectively. The top of the embankment is at elevation 6868'. Details for the design can be viewed on Drawing 5-68.

Structure 7 is a square impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with a 24" primary spillway with an oil skimmer and an open channel secondary spillway that will have 9" D50 rip-rap. 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 133.9 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-69.

Structure 8 is a triangle impoundment 10 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 28.4 acres. The cleanout and spillway elevation are 6884' and 6894' respectively. The top of the embankment is at elevation 6896'. Details for the design can be viewed on Drawing 5-70.

Structure 9 is a triangle impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 23.6 acres. The cleanout and spillway elevation are 6856' and 6864' respectively. The top of the embankment is at elevation 6866'. Details for the design can be viewed on Drawing 5-71.

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 for the Coal Hollow Project and North Private Lease. Detailed designs and calculations are provided in this section, Drawings 5-26 through 5-32 and Appendix 5-2. No other impoundments are anticipated.

At some times it may be necessary to discharge water from the sediment ponds at the Coal Hollow Mine. The approved Coal Hollow UPDES permit (Appendix 7-12) allows for discharges.

733.200 Permanent and Temporary Impoundments

All impoundments have been designed and constructed using current, prudent engineering practices and have been designed to comply with the requirements of 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 R645-301-733.226, R645-301-743.240, and R645-301-743.

No impoundments or sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) exist or are planned within the Mine Permit Area. Should impoundments and sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) become necessary, compliance with the requirements of MSHA, 30 CFR 77.216 will be met.

All ten planned impoundments have been evaluated by a professional engineer to ensure stability of each structure. The stability analysis performed resulted in a static safety factor of at least 2.2 for each structure. The details for this analysis can be viewed in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-12 for the North Private Lease.

No permanent impoundments are planned in the project area.

If any examination or inspection discloses that a potential hazard exists, the person who examined the impoundment will promptly inform the Division according R645-301-515.200.

734 Discharge Structures

Discharge structures will be constructed and maintained to comply with R645-301-744.

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 the required design capacities are available.

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 6 hour duration, 100 year storm event even though they are not expected to be used. They will have rip-rap min 6” to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways. Also, impoundment 3 will have a decant installed at the 6808 elevation that will allow for the pond level to be managed and to still be able to contain the 100 year 24 hour event.

Impoundments 1, 1B, 2, 5, 6, 7, 8 and 9 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24” diameter pipes that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these three impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

Disposal of Excess Spoil

Areas designated for the disposal of excess spoil and excess spoil structures will be constructed and maintained to comply with R645-301-745.

Details of proposed excess spoil disposal plans are presented in Chapter 5, Section 535 of this MRP and are summarized below.

A geotechnical analysis has been completed for the proposed excess spoil structure. This analysis estimates the long-term safety factor to be 1.6 to 1.7 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structure will be stable under all conditions of construction. This construction will occur only in the designated excess spoil area as shown on Drawing 5-3 and 5-35. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1.

The excess spoil is planned to be placed in an area where natural grades range from 0 to 5%. This is one of the most moderately sloping locations in the Permit Area. Stability of this structure is estimated to be 1.6 to 1.7 based on the Appendix 5-1.

Geotechnical borings were completed in the foundation of the proposed disposal area. Laboratory analysis of these borings has also been completed. Details of this analysis can be viewed in Appendix 5-1.

Permanent slopes for the proposed excess spoil will not exceed 3h:1v (33 percent), therefore no keyway cuts have been proposed in the design. Appendix 5-1 details the stability analysis for the proposed structure.

Excess spoil will not be disposed of in underground mine workings.

Horizontal lifts will not exceed four feet in thickness unless otherwise approved by the Division. The lifts will be concurrently compacted to meet 85% of the standard Procter. The geotechnical analysis (Appendix 5-1), provides information showing that these construction standards will provide mass stability and will prevent mass movement during and after construction. The excess spoil will be graded to provide drainage similar to original flow patterns. Topsoil and subsoil as designated in Chapter 2 will be removed and separated from other materials prior to placement of spoil.

A description of the character of the bedrock and any adverse geologic conditions in presented in Appendix 5-1.

Spring and seep survey information is provided on Drawing 7-1. There are no springs or seeps identified in the excess spoil area.

There are no historical underground mining operations in the proposed excess spoil area. There are future underground operations proposed.

There are no rock chimneys or drainage blankets proposed.

A stability analysis including strength parameters, pore pressures and long-term seepage conditions is presented together with all supporting data in Appendix 5-1.

Neither rock-toe buttresses nor key-way cuts are required under R645-301-535.112 or R645-301-535.113.

No valley fills or head-of-hollow fills are proposed.

No durable rock fills are proposed.

No disposal of waste on preexisting benches is planned

The excess spoil structure and fill above approximate original contour are the only alternative specifications proposed. A geotechnical analysis has been completed for this proposal and can be viewed in Appendix 5-1. All other mined areas will be restored to approximate original contour.

735 Coal Mine Waste

Areas designated for disposal of coal mine waste and coal mine waste structures will be constructed and maintained to comply with R645-301-746.

No structures for the disposal of coal mine waste are planned.

736 Noncoal Mine Waste

Noncoal mine waste will be stored and final disposal of noncoal mine waste will comply with R645-301-747

Noncoal mine waste, including but not limited to grease, lubricants, paints, flammable liquids, garbage, machinery, lumber and other combustible materials generated during coal mining and reclamation operations will be temporarily stored in a controlled manner. Final disposal of noncoal mine wastes will consist of removal from the project area and transportation to a State-approved solid waste disposal area.

Only sizing of the coal is proposed. This process will not produce any waste.

At no time will any noncoal mine waste be deposited in a refuse pile or impounding structure, nor will any excavation for a noncoal mine waste disposal site be located within eight feet of any coal outcrop or coal storage area.

Notwithstanding any other provision to the R645 Rules, any noncoal mine waste defined as "hazardous" under 3001 of the Resource Conservation and Recovery Act (RCRA) (Pub. L. 94-580, as amended) and 40 CFR Part 261 will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing regulations.

Debris, acid-forming, toxic-forming materials and materials constituting a fire hazard will be identified and disposed of in accordance with R645-301-528.330, R645-301-537.200, R645-301-542.740, R645-301-553.100 through R645-301-553.600, R645-301-553.900, and R645-301-747. Appropriate measures will be implemented to preclude sustained combustion of such materials.

Plans do not include using dams, embankments or other impoundments for disposal of coal, overburden, excess spoil or coal mine waste.

738 Temporary Casing and Sealing of Wells

Wells constructed for monitoring groundwater conditions in the Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

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.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of “Administrative Rules for Water Well Drillers”, State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer’s office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer’s office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

740 DESIGN CRITERIA AND PLANS

741 GENERAL REQUIREMENTS

742 SEDIMENT CONTROL MEASURES

742.100 General Requirements

742.110 Design

Appropriate sediment control measures will be designed, constructed and maintained using best technology currently available to prevent to the extent possible, contributions of sediment to stream flow or to runoff outside the permit area; meet the effluent limitations under R645-301-751; and minimize erosion to the extent possible.

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow 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. These impoundments in combination with the ditches will be the primary method that will be used to control sediment resulting from disturbed areas. In addition to the drawings and Appendix 5-2 , the following is a description of the structures:

A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas. Each impoundment is designed to contain the run off from a 100 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-26. The following table summarizes the final capacity results for each impoundment:

Coal Hollow Mine 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 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 472 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 388 acres post mining; 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.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the North Private Lease. Prior to removal of topsoil and construction of these impoundments, silt fences will be installed at the down gradient disturbance boundary for each impoundment. Once construction has been completed these silt fences can be replaced with excelsior logs for long term sediment control. Each impoundment is designed to contain at minimum the run off from a 10 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-65. Additionally, as depicted on drawings 5-47, 5-48 and 65, a silt fence or berm will be constructed along the eastern boarder of Area 1.

The following table summarizes the final capacity results for each impoundment:

North Private Lease Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

Structure 5 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 18.8 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-67.

Structure 6 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 24.0 acres. The cleanout and spillway elevation are 6858' and 6866' respectively. The top of the embankment is at elevation 6868'. Details for the design can be viewed on Drawing 5-68.

Structure 7 is a square impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with a 24" primary spillway with an oil skimmer and an open channel secondary spillway that will have 9" D50 rip-rap. 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 133.9 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-69.

Structure 8 is a triangle impoundment 10 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 28.4 acres. The cleanout and spillway elevation are 6884' and 6894' respectively. The top of the embankment is at elevation 6896'. Details for the design can be viewed on Drawing 5-70.

Structure 9 is a triangle impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. 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 23.6 acres. The cleanout and spillway elevation are 6856’ and 6864’ respectively. The top of the embankment is at elevation 6866’. Details for the design can be viewed on Drawing 5-71.

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.

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

The diversions ditches for the Coal Hollow Mine will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the four 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:

Coal Hollow Mine 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	14.8	0.5	6.8	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	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen 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 10 year, 6 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. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	0.60	0.29	3.50	0.71
DD-6	0.0	0.025	6.22	0.20	0.19	2.85	0.81
DD-7	0.0	0.025	4.84	0.28	0.22	2.82	0.78
DD-8	0.0	0.025	5.16	0.28	0.22	2.89	0.78
DD-9	0.0	0.025	8.42	0.80	0.30	4.51	0.70
DD-10	0.0	0.025	2.67	0.80	0.37	2.93	0.63
DD-11	0.0	0.025	6.07	0.51	0.27	3.56	0.83
DD-12	0.0	0.025	7.00	1.15	0.35	4.61	0.65
DD-13	0.0	0.025	2.04	3.32	0.66	3.78	0.84
UD-14	0.0	0.025	1.28	1.09	0.48	2.40	0.32
UD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	4.54	0.74	4.17	0.76
DD-17	0.0	0.025	2.12	1.28	0.46	3.02	0.34
UD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83

UD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

These structures will retain sediment within the disturbed area. The diversion ditches are designed in manner that will minimize erosion of the channels and will divert runoff from disturbed areas to the impoundments. These sediment control measures are designed to meet the effluent limitations under R645-301-751.

742.126

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.

742.200 Siltation Structures

Siltation structures have been designed in compliance with the requirements of R645-301-742.

Miscellaneous controls such as silt fence and berms are proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-26. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2 for the Coal Hollow Mine. The proposed locations for these structures are shown on Drawing 5-47. Details associated with these structures can be viewed in Appendix 5-13 for the North Private Lease.

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.

742.212

Siltation structures including ponds and ditches will be the first features built when beginning a new area.

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 for the Coal Hollow Mine 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:

Coal Hollow Mine 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

The ponds for the North Private Lease have been designed with excess capacity to allow for 3 years of sediment storage volume. The following table provides the design capacities in relation to a 24 hour duration, 10 year storm event:

North Private Lease Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

These sedimentation ponds will be surveyed at least annually to ensure that sufficient sediment storage is available in the impoundment. Sediment will be removed from the ponds as required based on results from the surveys. Calculations related to these design capacities can be viewed in Appendix 5-2 for the Coal Hollow Mine and in Appendix 5-12 for the North Private Lease. Stage-Storage curves for each pond can be viewed on Drawings 5-28 through 5-31 and 5-65 through 5-67.

742.221.32 The sedimentation ponds in the Coal Hollow Mine are designed to provide detention for a 100 year, 24 hour duration storm event. Calculations for this design can be viewed in Appendix 5-2. The sedimentation ponds in the North Private Lease are designed to provide detention for a 10 year, 24 hour duration storm event. Calculations for this design can be viewed in Appendix 5-12. This design standard is expected to keep discharges from the structure at a minimum and allow adequate settlement time to meet Utah and federal effluent limitations. In the event it becomes necessary to decant water to satisfy the required storage volumes, ACD will use a 4" gasoline driven pump to decant excess water. Water will be required to remain in the pond for a minimum of 24 hours prior to the beginning of decant operations and be discharged through the discharge point approved under UPEDES permit No. UTG04027 following all applicable monitoring protocol under this permit.

742.221.33 The sedimentation ponds at the Coal Hollow Mine are designed for a 100 year, 24 hour storm event which significantly exceeds a 10 year, 24 hour precipitation event. The 100 year, 24 hour event in the Alton area is 3.1 inches of precipitation. The sedimentation ponds at the North Private Lease are designed for a 10 year, 24 hour storm event. The 10 year, 24 hour precipitation event in this same location is approximately 2.0 inches of precipitation. The design standard used for the Coal Hollow project is 155% of the precipitation for the required "design event".

742.221.34 Each pond will be constructed with an emergency spillway, should the capacities of the ponds ever be exceeded. These spillways will provide a nondestructive route for storm water discharge, though the capacities of the ponds are not expected to be exceeded. The design capacities of the ponds are expected to contain each storm event and therefore will provide sufficient detention time to meet Utah and federal effluent limitations. The following is a description of each spillway:

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 24 hour duration, 100 year storm event even though they are not expected to be used during normal operations. They will have rip-rap min. 6" to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1, 1B, and 2 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24" diameter pipes that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these two impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

Impoundments 5, 6, 7, 8 and 9 will be constructed with a drop pipe primary spillway and an open channel emergency spillways system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. The drop-pipe spillways are 18" diameter pipes for impoundments 5, 6, 8 and 9 and a 24" diameter pipe for impoundment 7 that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. The open channel emergency spillways are designed to discharge a 6 hour duration, 25 year storm event even though they are not expected to be used during normal operations. Impoundments 5, 6, 8 and 9 will have 6" rip-rap (D-50) and impoundment 7 will have 9" rip-rap (D-50) with erosion control fabric beneath to minimize erosion and spillway slopes will not exceed 3h:1v

742.221.35 Regular inspections of the sediment pond system during construction and operations will identify any deficiencies that could cause short circuiting. Design standards for the system will ensure proper functioning during extreme storm events which makes it highly unlikely that issues related to short circuiting could occur during normal operations.

742.221.36 Surveys of the pond system will be conducted at least annually. These surveys will be compared against the required “design event” capacity for each pond. Sediment removal will occur as needed to maintain the required capacity.

742.221.37 Geologic conditions in the areas where sediment ponds will be constructed are suitable to the proposed use. Excessive settling of the ponds is not expected based on the high clay content of the soils. Embankments will be constructed in maximum two foot lifts to promote compaction during the construction process, reducing settling during operations. Supporting data for compaction can be viewed in Appendix 5-1.

742.221.38 Any sod, large roots, and/or frozen soil will be removed from sedimentation ponds. No coal processing will be conducted as part of the Coal Hollow Project; therefore wastes from this type of process will not be present.

742.221.39 Embankments will be constructed in maximum two foot lifts to promote compaction during the construction process, reducing settling during operations. Supporting data for this compaction method can be viewed in Appendix 5-1.

742.222 Sedimentation ponds for the Coal Hollow Mine or the North Private Lease do not meet the size or other qualifying standard for MSHA, 30 CFR 77.216(a).

742.223 Each sedimentation pond at the Coal Hollow Mine will be constructed with a spillway that will function as both the emergency and principle spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Spillway Flow Capacities

Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
1	30.4	37.4
2	0.8	30.5
3	2.8	11.5
4	2.4	11.5
1B	6.06	23.9

The drop pipe spillways for impoundments 1, 1B, and 2 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be rip-rap min. 6" and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected.

742.224 Each sedimentation pond at the North Private Lease will be constructed with a principle spillway and an emergency spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Primary Spillway Flow Capacities		
Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
5	2.23	9.66
6	2.85	9.66
7	10.11	20.80
8	3.42	9.66
9	3.60	9.66

The drop pipe spillways for all impoundments will be of nonerodible construction. The open channel spillways for impoundments 5, 6, 8 and 9 will be rip-rap (D50) 6" underlain with erosion fabric and are designed to carry sustained flows. The open channel spillways for impoundment 7 will be rip-rap (D50) 9" underlain with erosion fabric and is designed to carry sustained flows.

742.225 Either the requirements of 742.223.1 or 742.223.2 will be met for each sediment impoundment.

742.226 No exceptions to the sediment pond location guidance are requested

742.230 <u>Other Treatment Facilities</u>

If other treatment facilities become necessary, they will be designed to treat the 10-year, 24-hour precipitation event unless a lesser design event is approved by the Division based on terrain, climate, other site-specific conditions and a demonstration by the operator that the effluent limitations of R645-301-751 will be met.

No other treatment facilities are planned for the Coal Hollow Project.

742.240 Exemptions

Not Applicable

742.300 Diversions

742.310 General Requirements

742.311 There are no flows from mined areas that have been abandoned prior to May 3, 1978 at the Coal Hollow Project. Diversions at the Coal Hollow Project are planned to minimize water from disturbed areas from directly discharging into drainages without first being treated and to also prevent water from upland, adjacent areas from entering the project area. Four temporary diversion ditches are planned and one temporary diversion of Lower Robinson Creek. Two diversions will be primarily used to route water from upland, undisturbed areas away from the planned disturbed areas. Diversion ditch 2 has been split to minimize the amount of water from upland routed to Pond 2 (see drawing 5-34), 2B will route water from upland to Lower Robinson Creek and 2A will route water from disturbed area to Pond 2. Diversion ditch 4 is planned to direct water from disturbed areas into sediment impoundment Pond 4. The temporary diversion of Lower Robinson Creek is for maximum recovery of coal and will route flows around the mining area. Each temporary diversion has been designed to only carry runoff from areas that will or potentially could be affected by the mining operations, except Lower Robinson Creek diversion which will carry intermittent flows from the upstream watershed. Diversion locations were selected to generally carry runoff to the drainage paths that the precipitation would originally follow. These parameters were followed in the designs to minimize impacts to the overall hydrological balance within the permit and adjacent areas. Diversions will not be used to route water into underground mines. Specific design parameters are discussed in the following sections (R645-301-742.312.1 to 742.314). There are no flows from mined areas that have been abandoned prior to May 3, 1978 at the North Private Lease. Diversions at the North Private Lease are planned to minimize water from disturbed areas from directly discharging into drainages without first being treated and to also prevent water from upland, adjacent areas from entering the project area. Fifteen temporary diversion ditches are planned. Four diversions will be primarily used to route water from upland, undisturbed areas away from the planned disturbed areas. Each temporary diversion has been designed to only carry runoff from areas that will or potentially could be affected by the mining operations. Diversion locations were selected to generally carry runoff to the drainage paths that the precipitation would originally follow. These parameters were followed in the designs to minimize impacts to the overall hydrological balance within the permit and adjacent areas. Diversions will not be used to route water into underground mines. Specific design parameters are discussed in the following sections (R645-301-742.312.1 to 742.314).

742.312

The construction of and the operational activities at the proposed alluvial groundwater interceptor trench systems will be performed according to good engineering practices and in compliance with all applicable State and Federal rules. To ensure the safety of construction personnel during construction of the drain systems, work will be performed primarily by the equipment operators from within the operator compartments of the employed equipment. Equipment operators will be adequately trained on the hazards associated with the excavation work at the drain sites. Construction personnel will not be allowed to enter excavated trench areas during the drain construction operations other than as allowed by applicable State and Federal laws and regulations. Where necessary, work outside of equipment operator compartments will be performed in a prudent and safe manner. The excavated drain areas will be promptly backfilled after the drain construction materials have been emplaced.

A physical barrier will be constructed and maintained at alluvial groundwater interceptor drain discharge structures to prevent mine personnel from falling into the discharge structure.

742.312 Each diversion in the Coal Hollow Mine was designed to ensure stability and to minimize erosion. In order to accomplish this standard, the diversions were each designed for peak flows during a 100 year, 24 hour storm event. The following summarizes the steps used:

The channel sizing for the four proposed temporary 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	14.8	0.5	6.8	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	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen 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 10 year, 6 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. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	0.60	0.29	3.50	0.71
DD-6	0.0	0.025	6.22	0.20	0.19	2.85	0.81
DD-7	0.0	0.025	4.84	0.28	0.22	2.82	0.78
DD-8	0.0	0.025	5.16	0.28	0.22	2.89	0.78
DD-9	0.0	0.025	8.42	0.80	0.30	4.51	0.70
DD-10	0.0	0.025	2.67	0.80	0.37	2.93	0.63
DD-11	0.0	0.025	6.07	0.51	0.27	3.56	0.83
DD-12	0.0	0.025	7.00	1.15	0.35	4.61	0.65
DD-13	0.0	0.025	2.04	3.32	0.66	3.78	0.84
UD-14	0.0	0.025	1.28	1.09	0.48	2.40	0.32
UD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	4.54	0.74	4.17	0.76
DD-17	0.0	0.025	2.12	1.28	0.46	3.02	0.34
UD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83
UD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

As shown in the above tables, flow depths will be shallow, flow velocity will be manageable for temporary flow conditions and sufficient freeboard will be present during a flood event. These conditions will provide diversion stability, protection against flooding and prevent to the extent possible additional contributions of suspended solids to streamflow outside the permit area. These diversions are designed to comply with all applicable local, Utah and federal laws and regulations. Further details related to the temporary diversion designs can be viewed in Appendix 5-2 and Appendix 5-12.

Based on the size of the watershed for Lower Robinson Creek, a different method of analysis was used than the method used for the other diversions. The HEC-1 program was used for this analysis and extra erosion protection has been included as part of the design. The channel was designed to safely handle the flows from a 100 year, 6 hour storm event. This diversion will be further discussed in section 742.320 Diversion of Perennial and Intermittent Streams.

742.313 The four temporary diversions at the Coal Hollow Mine will be reclaimed when they are no longer necessary. This will occur once final reclamation is determined to be sufficient within the project area and the sediment impoundments are no longer needed. This is anticipated to occur in the fourth year of operations.

The Lower Robinson Creek temporary diversion will be constructed in a responsible manner. This diversion will experience some erosion during flood events but erosion rates are expected to be generally less than those in the original channel above and below the diversion. The detailed design for this diversion can be viewed in Drawings 5-20 and 21. Calculations related to this diversion design can be viewed in Appendix 5-3.

The fifteen temporary diversions at the North Private Lease will be reclaimed when they are no longer necessary. This will occur once final reclamation is determined to be sufficient within the project area and the sediment impoundments are no longer needed. This is anticipated to occur in the sixth year of operations.

742.320 <u>Diversion of Perennial and Intermittent Streams.</u>

742.321 Temporary diversion of one intermittent stream is planned for the Coal Hollow Project. The planned diversion is in a length of the stream that appreciable flows only occur during storm events and snow melt periods. This diversion is necessary to recover coal located in the northwest corner of the project area. The diversion would provide mining in an area that is 22 acres and contains approximately 400,000 tons of recoverable coal. Without this diversion, most of this area could not be mined.

742.322 The original unmodified channel immediately upstream and downstream from the Lower Robinson Creek diversion has excessive erosion and is not in stable condition. The channel has incised deeply and has developed into a channel that has a capacity significantly greater than any anticipated storm events. Since these conditions are not desirable for the area, the diversion design instead has dimensions that are suitable to pass a 100 year, 6 hour storm event in compliance with R645-301-742.323.

742.323 The temporary Lower Robinson Creek diversion has been designed to safely pass a 100 year, 6 hour storm event. The watershed for this drainage is 3.64 square miles and has a peak flow of 83.5 cubic feet per second during a 100 year, 6 hour event. Minimum dimensions for carrying this flow was found to be a channel that has the following dimensions:

Bottom width: 2 feet
Side slopes: 3h:1v
Minimum slope height: 3 feet (1 foot freeboard added)

Details related to the design calculations are provided in Appendix 5-3. Rip-rap will be appropriately placed to minimize erosion of the channel.

Cross sections of the channel design are shown in Drawing 5-21. As shown in the drawing, all sections of the diversions exceed the minimum design standard. A plan view of the diversion design can be viewed in Drawing 5-20.

742.324 Design of the Lower Robinson Creek Diversion has been certified by a qualified registered professional engineer.

742.330 Diversion of Miscellaneous Flows.

742.323

As part of the reclamation process, Lower Robinson Creek will be reconstructed to its approximate original location. The design for this reconstruction is shown on Drawings 5-20A and 5-21A. This design includes considerable improvements to the channel compared to the channel's current condition. The current condition is such that less than 25% of the channel within the disturbed area has a flood plain present and most of the slopes are near the angle of repose with fair to poor vegetative cover. The reconstructed sides of the channel for the entire length reconstructed. Sharp corners in the original alignment have been rounded to sinuous curve shapes and rip-rap will be installed in the bottom section of the channel to minimize erosion. The flood plain will be seeded and covered with erosion matting to control erosion until natural vegetative condition can be attained.

742.331 Diversion of miscellaneous flows at the Coal Hollow Mine is planned using four diversion ditches. Two diversions will be primarily used to route runoff from upland, undisturbed areas away from the planned disturbed areas. Diversion ditch 2 has been split to minimize the amount of water from upland routed to Pond 2 (see drawing 5-34), 2B will route water from upland to Lower Robinson Creek and 2A will route water from disturbed area to Pond 2. Diversion ditch 4 is planned to direct water from disturbed areas into sediment impoundment Pond 3. The locations of these diversions along with the associated watersheds can be viewed on Drawings 5-27, 5-33 and 5-34. Calculations related to the diversions can be viewed in Appendix 5-2.

Diversion of miscellaneous flows at the North Private Lease is planned using fifteen diversion ditches. Four diversions will be primarily used to route runoff from upland, undisturbed areas away from the planned disturbed areas. The locations of these diversions along with the associated watersheds can be viewed on Drawings 5-63, and 5-64. Calculations related to the diversions can be viewed in Appendix 5-12.

742.332 Each diversion at the Coal Hollow Mine was designed for stability and to minimize erosion. In order to accomplish this standard, the diversions were each designed for peak flows during a 100 year, 24 hour storm event. The following summarizes the steps used:

The channel sizing for the four proposed temporary 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 peak 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	14.8	0.5	6.8	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	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen 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 10 year, 6 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. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	4.77	0.64	5.89	0.36
DD-6	0.0	0.025	6.22	2.34	0.47	5.27	0.53
DD-7	0.0	0.025	4.84	5.34	0.67	5.89	0.83
DD-8	0.0	0.025	5.16	5.33	0.66	6.03	0.84
DD-9	0.0	0.025	8.42	0.70	0.28	4.36	0.72
DD-10	0.0	0.025	0.43	0.70	0.49	1.43	0.51
DD-11	0.0	0.025	6.07	5.22	0.64	6.38	0.86
DD-12	0.0	0.025	0.50	8.36	1.22	2.81	0.78
DD-13	0.0	0.025	2.04	22.80	1.36	6.13	0.64
DD-14	0.0	0.025	1.28	0.55	0.37	2.03	0.63
DD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	11.89	1.06	5.31	0.94
DD-17	0.0	0.025	2.12	11.38	1.04	5.22	0.96
DD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83
DD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

As shown in the above tables, flow depths will be shallow, flow velocity will be manageable for temporary flow conditions and sufficient freeboard will be present during a flood event. These conditions will provide diversion stability, protection against flooding and prevent to the extent possible additional contributions of suspended solids to stream flow outside the permit area. These diversions are designed to comply with all applicable local, Utah and federal laws and regulations. Further details related to the temporary diversion designs can be viewed in Appendix 5-2 for the Coal Hollow Mine and Appendix 5-12 for the North Private Lease.

742.333 All four miscellaneous flow diversions planned for the Coal Hollow Mine are temporary and will be reclaimed when no longer necessary for sediment and storm water control. Therefore, the channels must safely pass the peak runoff from a 2 year, 6 hour event. As previously described, these diversions have been designed to pass a 100 year, 24 hour storm event which significantly exceeds this required design standard. Precipitation from a 100 year, 24 hour storm event for this area is 3.1 inches while precipitation for the 2 year, 6 hour event is less than 1 inch.
All fifteen miscellaneous flow diversions planned for the North Private Lease are temporary and will be reclaimed when no longer necessary for sediment and storm water control. Therefore, the channels must safely pass the peak runoff from a 2 year, 6 hour event. As previously described, these diversions have been designed to pass a 10 year, 24 hour storm event which significantly exceeds this required design standard. Precipitation from a 10 year, 24 hour storm event for this area is 2.39 inches while precipitation for the 2 year, 6 hour event is less than 1 inch.

742.400 Road Drainage

742.410 All Roads

742.411 To ensure environmental protection and safety appropriate for the planned duration and use, limits have been incorporated in the road designs for the Coal Hollow Project and the North Private Lease. These limits are applied to drainage control and culvert placement/sizing. These limits take into consideration the type and size of equipment planned for the operation. The following is a description of roads along with the design limits and standards that will be incorporated into construction:

Two primary Mine Haul roads at the Coal Hollow Mine are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to pits 1 through 15 (pits shown on

Drawing 5-10). This road will be approximately 2,600 feet in length and will be utilized mainly during the first two years of mining. There will be three culverts installed along this road all sized for a 100 year, 6 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix 5-3. The third culvert is a crossing over a diversion ditch that will route water mainly from disturbed areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds south to approximately pit 25. This road is approximately 2,500 feet in length and will be used for the south pits 16 through 30. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert.

The following specifications apply to these two Primary Mine Haul roads:

1) Roads will be approximately 80' in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The underground mine portal access and haul road in Pit 10 will also be a primary road. This road is accessed from the main haul road from the coal unloading area. The underground access/haul road will be constructed to the same specifications for the haul roads above, except that the road may be narrowed to a 40 foot width.

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width.

The location and details for all these roads can be viewed on Drawings 5-3 and 5-22 through 5-24.

In addition to the two primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road system will have six culverts and selectively located berms to appropriately route water to the two sediment impoundments for the facilities area. The location of these culverts and berms is shown on Drawing 5-3. This road is referred to as “Facilities Roadway” and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

All roads will be maintained on an as needed basis using motor graders, water trucks for dust suppression, and other equipment as necessary. Crushed stone and/or gravel will be used as a surface course for primary roads outside the active mining area, and may be used as needed for ramps and travelways within the pit. Should the roads be damaged by a catastrophic event, such as an earthquake or a flood, repairs will be made as soon as possible after the damage has occurred or the road will be closed and reclaimed.

Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. The water from roads in the project area will not directly discharge to drainages outside the project area without first being treated by flowing through a sediment impoundment. In locations where there are culvert crossings (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles.

Transportation facilities for the North Private Lease will consist of two primary road, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road will extend from the entrance to the permit area to the North end of Pit 6. This road is approximately 1755 feet in length. This road is referred as the “North Pits Haul Road”. The second primary haul road “Kanab Creek Crossing” extends from an intersection with the North Pits Haul Road and cross to the East side of Kanab Creek. This road is approximately 700 feet in length. There is one culvert crossing along this road to cross Kanab Creek. This culvert will be a 172 inch culvert sized for maximum anticipated flows in Kanab Creek.

The following specifications apply to these Primary mine haul roads:
1) Roads will be approximately 80’ in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18” of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Berms placed as necessary along fills

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The location and details for the Primary Mine Haul road can be viewed on Drawings 5-58, through 5-64.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travel ways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

742.412 No roads will be located in the channel of an intermittent or perennial stream.

742.413 Primary roads constructed utilized during mining operations have been designed and located to route runoff from the roads to the sediment impoundment system. By routing the runoff to this system, sedimentation and flooding downstream resulting from the roads will be minimized. All other roads located within the active mining area will also follow this standard and runoff from the roads will not be directly discharged to drainages outside the permit area.

742.420 Primary Roads

742.421 To minimize erosion, primary roads will be constructed with a rock surface with minimal cut and fill slopes. These roads are located in the most practicable, stable areas within the permit boundary and mostly outside of the designed pits. These locations can be reviewed on Drawing 5-22 through 5-22G. Further descriptions of these roads can be viewed in Section 742.423.1 and 742.111.

742.422 There are no stream fords by primary roads at the Coal Hollow Project.

742.423 <u>Drainage Control</u>

- 742.423.1 Two primary Mine Haul roads are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to pits 1 through 15 (pits shown on Drawing 5-10). This road will be approximately 2,600 feet in length and will be utilized mainly during the first two years of mining. There will be three culverts installed along this road all sized for a 100 year, 24 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix A5-3. The third culvert is crossing over a diversion ditch that will route water mainly from disturbed areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

  The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds south to approximately pit 25. This road is approximately 2,500 feet in length and will be used for the south pits 16 through 30. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert sized for maximum anticipated flows in the diversion.

  The following specifications apply to these Primary mine haul roads:
  1) Roads will be approximately 80' in width
  2) Approximately a 2% crown
  3) Approximately one foot deep cut ditches along shoulders for controlling storm water
  4) 18" of crushed rock or gravel for road surfacing
  5) Cut and fill slopes of 1.5 h:1v
  6) Minimum fill over each culvert will be 2 times diameter of culvert
  7) Berms placed as necessary along fills

  The location and details for Primary Mine Haul roads can be viewed on Drawings 5-3 and 5-22 and 5-23.

  In addition to the two roads primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road system will have four culverts and selectively located berms appropriately placed to route water to the two sediment impoundments for the facilities area. The location of these culverts and berms is shown on Drawing 5-3.

This road is referred to as “Facilities Roadway” and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

In addition to the primary roads that will be present during active mining, four additional roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- Road to Water Well with details shown on Drawing 5-22D
- Road to east C. Burton Pugh property with details shown on Drawing 5-22C
- County Road 136 (K3900) with details on Drawing 5-22E, 5-22F and 5-22G. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-38 and is expected to be completed by the end of Year 4.
- Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawings 5-37 along with the post mining topography. With the exception of the County Road, each road will be graded to complement the surrounding topography and drainages. Details for these roads are provided in the above referenced drawings.

County Road 136 will have a cut ditch on the up gradient side of the road as appropriate. The culvert located at the crossing of Lower Robinson Creek will remain. One culvert will be added at Station 21+66 as shown on Drawing 5-22E. For further details related to reestablishment of County Road 136, refer Drawings 5-22 through 5-22G and 5-35.

Transportation facilities for the North Private Lease will consist of two primary road, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road will extend from the entrance to the permit area to the North end of Pit 6. This road is approximately 1755 feet in length. This road is referred as the “North Pits Haul Road”. The second primary haul road “Kanab Creek Crossing” extends from an intersection with the North Pits Haul Road and cross to the East side of Kanab Creek. This road is approximately 700 feet in length. There is one culvert crossing along this road to cross Kanab Creek. This culvert will be a 172 inch culvert sized for maximum anticipated flows in Kanab Creek.

  The following specifications apply to this Primary mine haul roads:
  1) Roads will be approximately 80’ in width
  2) Approximately a 2% crown
  3) Approximately one foot deep cut ditches along shoulders for controlling storm

water
4) 18” of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h: 1v
6) Berms placed as necessary along fills

The location and details for the Primary Mine Haul road can be viewed on Drawings 5-56 thru 5-58.
The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

In addition to the primary roads that will be present during active mining, two roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- County Road 136 (K3900) with details on Drawing 5-61. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-76 and is expected to be completed by the end of Year 6.
- McDonalds Road (same specification as the County Road 136) with details on Drawing 5-62. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-76 and is expected to be completed by the end of Year 6.

The location of these roads is shown on Drawings 5-74 along with the post mining topography. With the exception of the County Road, each road will be graded to complement the surrounding topography and drainages. Details for these roads are provided in the above referenced drawings.

742.423.2 Drainage pipes and culverts will be constructed on a minimum 2% grade to avoid plugging. Minimum fill over culverts will be 2 times the diameter of the culvert itself to avoid collapsing. Grades going in and out of each culvert will be similar to the grade of the culvert itself to avoid erosion at the inlet and outlet.

742.423.3 Drainage ditches have been designed to pass a 100 year 24 hour storm event which will prevent uncontrolled drainage over the road surface and embankment. The watersheds associated with drainage in the project area are each relatively small (less than 400 acres) and are not expected to sustain flows that would carry significant debris through the project area. Therefore, trash racks and debris basins are not expected to be necessary at the Coal Hollow Project.

742.423.4 One natural intermittent stream channel is planned to be diverted. This channel is referred to as Lower Robinson Creek and this diversion will be temporary. A section of this stream runs across an area that is planned for mining.

The Lower Robinson Creek diversion has been designed to safely pass a 100 year, 6 hour storm event. The watershed for this drainage is 3.64 square miles and has a peak flow of 83.5 cubic feet per second during a 100 year, 6 hour event. Minimum dimensions for carrying this flow were found to be a channel that has the following dimensions:

Bottom width: 2 feet
Side slopes: 3h:1v
Minimum slope height: 3 feet (1 foot freeboard added)

Details related for the design calculations are provided in Appendix 5-3. Rip-rap will be appropriately placed to minimize erosion of the channel.

Cross sections of the channel design are shown in Drawing 5-21. As shown in the drawing, all sections of the diversions exceed the minimum design standard. A plan view of the diversion design can be viewed in Drawing 5-20. This diversion design is in accordance with R645-301-731.100 through R645-301-731.522, R645-301.600, R645-301-731.800, R645-301-742.300, and R645-301-751.

Design of the Lower Robinson Creek Diversion has been certified by a qualified registered professional engineer.

742.423.5 All stream crossings are planned to be culverts designed to pass the 100 year, 6 hour storm event. There are no plans to use fords as stream crossings. Calculations for culvert sizing can be found in Appendix 5-3 for the Coal Hollow Mine and in Appendix 5-12 for the North Private Lease.

743 IMPOUNDMENTS

743.100 General Requirements

Five temporary impoundments are planned at the Coal Hollow Project and five temporary impoundments for the North Private Lease. Design for these structures are shown in Drawings 5-28 through 5-32 and 5-65 thru 5-67. These impoundments do not meet the criteria for Class B or C dams as specified in the U.S. Department of Agriculture, Natural Resources Conservation Service Technical Release 60.

743.110 None of the impoundments meet the criteria of MSHA, 30 CFR 77.216(a).

743.120 A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-11 for the North Private Lease. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31for the Coal Hollow Mine and Drawings 5-67 through 5-71 and Appendices 5-1, 5-2, 5-11 and 5-12 for each area.

Each impoundment is designed with a minimum freeboard of 2 feet. Based on the size of the impoundments and the relatively small size of the associated watersheds, this amount of freeboard will be sufficient to prevent overtopping from waves and/or storm events. These impoundments do no meet the criteria for Class B or C dams.

743.130

Each impoundment will be constructed with a spillway that will function as both the emergency and principle spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Spillway Flow Capacities		
Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
1	30.4	37.4
2	0.8	30.5
3	2.8	11.5
4	2.4	11.5
1B	6.06	23.9
5	2.23	9.66
6	2.85	9.66
7	10.11	20.80
8	3.42	9.66
9	3.60	9.66

The drop pipe spillways for impoundments 1, 1B, 2, 5, 6 and 7 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be 6” minimum Rip Rap lined and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected.

The impoundments at the Coal Hollow project do not meet the criteria for either Class B or C dams or MSHA CFR 77.216 (a).

743.140

A professional engineer or specialist experienced in the construction of impoundments will inspect impoundments. Inspections will be made regularly during construction, upon completion of construction, and at least yearly until removal of the structure or release of the performance bond. The qualified registered professional engineer will promptly, after each inspection, provide to the Division, a certified report that the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 Rules. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded waters, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability. A copy of the report will be retained at or near the mine site.

The MRP does not contemplate construction of any impoundments meeting the NRCS Class B or C criteria for dams in TR-60, or the size or other criteria of 30 CFR Sec. 77.216.

743.200

No permanent impoundments are planned.

743.300

Design capacities for spillways exceed the 25 year, 6 hour event. The design capacities are provided in the table located in section R645-301-743.130.

744 DISCHARGE STRUCTURES

744.100

Each pond will be constructed with an emergency spillway, should the capacities of the ponds ever be exceeded. These spillways will provide a nondestructive route for storm water discharge, though the capacities of the ponds are not expected to be exceeded. The design capacities of the ponds are expected to contain each storm event and therefore will provide sufficient detention time to meet Utah and federal effluent limitations. The following is a description of each spillway:

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 24 hour duration, 100 year storm event even though they are not expected to be used during normal operations. They will have rip-rap min. 6” to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1, 1B, 2, 5, 6, 7, 8 and 9 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24” diameter pipes for impoundments

1,1B, 2 & 7 and 18” for impoundments 5, 6, 8 and 9 that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these two impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

The drop pipe spillways for impoundments 1, 1B, 2, 5, 6, 7, 8 and 9 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be rip-rap min. 6” and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected. The open channel spillways for impoundments 5, 6, 8 and 9 will be rip-rap (D50) 6”, impoundment 7 will be rip-rap (D50) 9” and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected. These designs will minimize erosion and disturbance to the hydrologic balance.

Details related to these designs can be viewed in Drawings 5-28 through 5-32 for the Coal Hollow and Drawings 5-67 through 5-71 for the North Private Lease.

744.200

Standard engineering design procedures have been used in the design of the discharge structures along with standard mining industry best management practices that are commonly used at surface mining operations.

745 <u>Disposal of Excess Spoil</u>

745.100 <u>General Requirements</u>

Excess spoil will be placed in designated disposal areas within the permit area, in a controlled manner to minimize the adverse effects of leachate and surface water runoff from the fill on surface and ground waters; ensure permanent impoundments are not located on the completed fill. Small depressions may be created if approved by the Division if they are needed to retain moisture or minimize erosion, create and enhance wildlife habitat or assist revegetation, and if they are not incompatible with the stability of the fill; and adequately cover or treat excess spoil that is acid- and toxic-forming with nonacid nontoxic material to control the impact on surface and ground water is accordance with R645-301-731.300 and to minimize adverse effects on plant growth and the approved postmining land use.

If the disposal area contains springs, natural or manmade water courses or wet weather seeps, the fill design will include diversions and underdrains as necessary to control erosion, prevent water infiltration into the fill and ensure stability.

Details of proposed excess spoil disposal plans are presented in Chapter 5, Section 535 of this MRP and are summarized below.

A geotechnical analysis has been completed for the proposed excess spoil structure. This analysis estimates the long-term safety factor to be 1.6 to 1.7 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structure will be stable under all conditions of construction. This construction will occur only in the designated excess spoil area as shown on Drawing 5-3 and 5-35. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1.

The excess spoil is planned to be placed in an area where natural grades range from 0 to 5%. This is one of the most moderately sloping locations in the Permit Area. Stability of this structure is estimated to be 1.6 to 1.7 based on the Appendix 5-1.

Geotechnical borings were completed in the foundation of the proposed disposal area. Laboratory analysis of these borings has also been completed. Details of this analysis can be viewed in Appendix 5-1 for the Coal Hollow Mine and in Appendix 5-11 for the North Private Lease.

Permanent slopes for the proposed excess spoil will not exceed 3h:1v (33 percent), therefore no keyway cuts have been proposed in the design. Appendix 5-1 details the stability analysis for the proposed structure.

Excess spoil will not be disposed of in underground mine workings.

Horizontal lifts will not exceed four feet in thickness unless otherwise approved by the Division. The lifts will be concurrently compacted to meet 85% of the standard Procter. The geotechnical analysis (Appendix 5-1), provides information showing that these construction standards will provide mass stability and will prevent mass movement during and after construction. The excess spoil will be graded to provide drainage similar to original flow patterns. Topsoil and subsoil as designated in Chapter 2 will be removed and separated from other materials prior to placement of spoil.

A description of the character of the bedrock and any adverse geologic conditions in presented in Appendix 5-1.

Spring and seep survey information is provided on Drawing 7-1. There are no springs or seeps identified in the excess spoil area.

There are no historical underground mining operations in the proposed excess spoil area. There are also no future underground operations proposed.

There are no rock chimneys or drainage blankets proposed.

A stability analysis including strength parameters, pore pressures and long-term seepage conditions is presented together with all supporting data in Appendix 5-1.

Neither rock-toe buttresses nor key-way cuts are required under R645-301-535.112 or R645-301-535.113.

No valley fills or head-of-hollow fills are proposed.

No durable rock fills are proposed.

No disposal of waste on preexisting benches is planned

The excess spoil structure and fill above approximate original contour are the only alternative specifications proposed. A geotechnical analysis has been completed for this proposal and can be viewed in Appendix 5-1. All other mined areas will be restored to approximate original contour.

745.200 <u>Valley Fills and Head-of-Hollow Fills</u>

Valley fills and head-of-hollow fills are not anticipated in the Coal Hollow Mine permit area.

745.300. <u>Durable Rock Fills.</u>

Durable rock fills are not anticipated in the Coal Hollow Mine permit area.

745.400. <u>Preexisting Benches.</u>

The disposal of excess spoil through placement on preexisting benches is not anticipated in the Coal Hollow Mine permit area.

746. COAL MINE WASTE

746.100. <u>General Requirements.</u>

No coal mine waste is anticipated.

746.200. <u>Refuse Piles.</u>

No refuse piles associated with coal mine waste are anticipated.

746.300. Impounding structures.

No impounding structures associated with coal mine waste are anticipated.

746.330. Drainage control.

No coal mine waste and associated drainage control is anticipated.

746.400. Return of Coal Processing Waste to Abandoned Underground Workings.

No coal mine processing waste is anticipated to be placed in underground workings.

747. DISPOSAL OF NONCOAL WASTE

747.100

Noncoal mine waste, including but not limited to grease, lubricants, paints, flammable liquids, garbage, machinery, lumber and other non combustible materials generated during coal mining and reclamation operations will be temporarily placed in covered dumpsters. This waste will be regularly removed from the project area and disposed of at a state approved solid waste disposal site outside the project area.

747.200

Noncoal mine waste will be stored in a metal, covered dumpster which will prevent storm precipitation or runoff from coming in contact with the waste.

747.300

No noncoal mine waste will be disposed of within the permit area with the exception perforated piping used in the construction of Alluvial Ground Water Drains . This will be left in place as mining advances. 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. Also, concrete pads for the generator and fan utilized in the underground operation will remain and will be covered with approximately 120’ of overburden.

748. Casing and Sealing of Wells.

Wells constructed for monitoring groundwater conditions in the Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

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.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

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.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

750 **PERFORMANCE STANDARDS**

All coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. Mining operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

751. Water Quality Standards and Effluent Limitations.

Discharges of water from areas disturbed by coal mining and reclamation operations will be made in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR Part 434.

Discharges from the Coal Hollow project are expected to be minimal based on the storm water and runoff controls that are described in R645-301-740. These structures are designed to contain large storm events without discharging runoff. Any runoff that does discharge will be treated through the sediment pond system.

Discharges from the proposed alluvial groundwater interceptor drain systems will be made in compliance with all applicable Utah and federal water quality laws and regulations. The proposed drain systems have been designed to intercept and discharge natural, un-contaminated up-gradient alluvial groundwater. The water from the alluvial groundwater intercept drain system will be collected in a gravel-packed underground drainage collection system and conveyed through pipes to a steel/concrete discharge structure from which the water will be discharged via pumping through a discharge hose to the discharge location. By managing the water in this matter, the potential for contamination of the water will be minimized. Prior to the initial discharge of water from newly constructed alluvial groundwater interceptor trench systems to receiving waters, the system will be adequately developed/pumped to remove residual fine-grained sediments that might be present in the system prior to discharge to receiving waters. Only suitable, uncontaminated groundwater will be discharged to the outfall location. The water quality and discharge rates from the alluvial groundwater intercept system will be monitored as per the requirements of the UPDES permit.

752. Sediment Control Measures

Sediment control measures will be located, maintained, constructed and reclaimed according to the plans and designs given under sections R645-301-732, R645-301-742 and R645-301-760. Plans and designs are described in these sections.

752.100
Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763. Plans and designs are described in these sections.

752.200. Road Drainage

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to R645-301-732.400, R645-301-742.400 and R645-301-762 and to achieve the following:

Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing all exposed surfaces in accordance with current, prudent engineering practices;

Control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area;

Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751;

Minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems; and

Refrain from significantly altering the normal flow of water in streambeds or drainage channels.

All plans and designs to meet these standards are described in the above referenced sections and on Drawings 5-22 through 5-24.

753. Impoundments and Discharge Structures

Impoundments and discharge structures will be located, maintained, constructed and reclaimed to comply with R645-301-733, R645-301-734, R645-301-743, R645-301-745 and R645-301-760. Plans and designs are described in these sections.

754. Disposal of Excess Spoil, Coal Mine Waste and Noncoal MineWaste.

Disposal areas for excess spoil, coal mine waste and noncoal mine waste will be located, maintained, constructed and reclaimed to comply with R645-301-735, R645-301-736, R645-301-745, R645-301-746, R645-301-747 and R645-301-760. Plans and designs are described in these sections.

755. Casing and Sealing of Wells

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

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.
Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

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.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of “Administrative Rules for Water Well Drillers”, State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer’s office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer’s office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

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.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

760. RECLAMATION

761. GENERAL REQUIREMENTS

Before abandoning a permit area or seeking bond release, the mine will ensure that all temporary structures are removed and reclaimed, and that all permanent sedimentation ponds, diversions, impoundments and treatment facilities meet the requirements of R645-301 and R645-302 for permanent structures, have been maintained properly and meet the requirements of the approved reclamation plan for permanent structures and impoundments. The mine will renovate such structures if necessary to meet the requirements of R645-301 and R645-302 and to conform to the approved reclamation plan.

762. ROADS

A road not to be retained for use under an approved postmining land use will be reclaimed immediately after it is no longer needed for coal mining and reclamation operations, including restoring the natural drainage patterns, and reshaping all cut and fill slopes to be compatible with the postmining land use and to complement the drainage pattern of the surrounding terrain.

The post mining land configuration is shown on 5-37 for the Coal Hollow Mine and 5-74 along with postmining road locations. Cuts and fills for the reclaimed roads will be minimal which allows for minor construction to grade roads to the approximate landform that existed prior to disturbance.

763. SILTATION STRUCTURES

763.100.

Siltation structures will be maintained until removal is authorized by the Division and the disturbed area has been stabilized and revegetated. In no case will the structure be removed sooner than two years after the last augmented seeding.

All impoundments will be reclaimed at the end of operations. The estimated timeline for removal of these structures are shown on Drawing 5-38 for the Coal Hollow Mine and 5-76 for the North Private Lease. Expected removal is year seven for the Coal Hollow and year six at the North Private Lease, 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.

763.200.

When the siltation structure is removed, the land on which the siltation structure was located will be regraded and revegetated in accordance with the reclamation plan and R645-301-358, R645-301-356, and R645-301-357.

No permanent sedimentation impoundments are planned.

764. STRUCTURE REMOVAL

The application will include 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 for the Coal Hollow and Drawing 5-76 for the North Private Lease. 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.

The facilities will be fully reclaimed at the end of mining operations with the exception of the water well shown on Drawing 5- 8B. The final contour for this area can be viewed on Drawing 5-37 for the Coal Hollow and Drawing 5-74 for the North Private Lease.

765. PERMANENT CASING AND SEALING OF WELLS

Wells constructed for monitoring groundwater conditions in the Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

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.

Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

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.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

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.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

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APPENDIX 7-18

Alluvial Groundwater Systems

(North Private Lease Area)

Characterization of Alluvial Groundwater Systems in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

20 July 2016

Alton Coal Development, LLC
Cedar City, Utah

Petersen Hydrologic, LLC
Consultants in Hydrogeology

Characterization of Alluvial Groundwater Systems in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

20 July 2016

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1.0 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 recently obtained a permit from the Utah Division of Oil, Gas and Ming to extend the mining operations at the existing Coal Hollow Mine into Area 1 at the North Private Lease area. In conjunction with mine permitting for Areas 2 and 3 at the North Private Lease, Alton Coal Development, LLC commissioned Petersen Hydrologic, LLC has performed an investigation of alluvial sediments and alluvial groundwaters in the North Private Lease area. The purpose of this document is to present the findings of this investigation to the Utah Division of Oil, Gas and Mining in consideration of permitting of mine Areas 2 and 3 at the North Private Lease.

The reader is referred to the mining and reclamation plan for the Coal Hollow Mine (C0250005) and specifically to Appendix 7-16 (Petersen Hydrologic, 2015) of the Coal Hollow Mine MRP which provides an analysis of groundwater and surface-water systems in the region for supporting information for this document. The reader is also referred to the report of an alluvial valley floor field investigation that was previously conducted in the North Private Lease area by Petersen Hydrologic, LLC, Mt. Nebo Scientific, Inc, and Long Resource Consultants, Inc (Petersen Hydrologic, et al, 2012). That document provides additional geologic, hydrologic, and hydrogeologic information from the North Private Lease area and is available as Appendix 7-17 in Chapter 7 of the Coal Hollow Mine MRP.

2.0 METHODS OF STUDY

The methods of study utilized in this hydrogeologic investigation, including data collection methods and investigative techniques, are described below.

- Information from previous drilling activities in the North Private Lease area were obtained and reviewed. These include the following:

    - Drilling information from two wells drilled by Utah International, Inc. in 1985 and 1986 as part of a previous mine permitting action with the Utah Division of Oil, Gas and Mining. Information from these wells was obtained in hard-copy format from the Utah Division of Oil, Gas and Mining.

    - Drilling, potentiometric, and water quality information obtained during the drilling and construction of the 13 monitoring wells installed in the North Private Lease and adjacent area during 2012 and 2013.

  - Geologic information (geologic logs and laboratory physical and chemical testing of sediments) from a series of 8 boreholes drilled in the North Private Lease area during 2012 as part of coal exploration activities in the lease.

- As part of this investigation, thirteen 2-inch monitoring wells were installed in the alluvial sediments in the North Private Lease area during March of 2016. These wells were drilled by Grimshaw Drilling, LLC of Cedar City, Utah using mud rotary drilling techniques. An additional 4-inch well (CN3-81) was installed in the gravel-bearing alluvium for use in aquifer pump testing.

- Also as part of this investigation, four 1-inch direct-push piezometers were installed along the banks of Kanab Creek immediately down-gradient (south) of the North Private Lease area. These wells were installed by Clement Drilling and Geophysical of Cedar Hills, Utah.

- Monitoring well ground coordinates and collar elevations were determined by ACD personnel using survey-grade GPS. Elevations of the water surface along Kanab Creek were also surveyed by ACD personnel.

- Samples for water quality analysis were collected from selected monitoring wells for laboratory water quality analysis. Laboratory water quality measurements were performed by Chemtech-Ford Laboratories of Murray, Utah, which is a Utah state-certified analytical laboratory. Information on laboratory analytical methods is provided on the Chemtech-Ford laboratory reporting sheets in Attachment E.

- An aquifer pump test was performed in the alluvial groundwater systems in the North Private Lease area during the period from 27 April 2016 to 1 May 2016. The 4-inch well (CN3-81) was utilized for the pumping well, with a pumping period of 56 hours. Twenty-two surrounding wells were monitored as observation wells during the test. Antecedent and recovery data were also collected during the test. The well was continuously pumped during the 56 hour period at an average rate of approximately 28.8 gpm using a Grundfos RediFlow 3 submersible pump and gasoline powered electrical generator.

- Potentiometric levels in wells were monitored during the test using a Waterline Envirotech, Ltd. Model 150 tape, a Waterline Envirotech, Ltd. Model 500 coaxial water-level indicator, or a Geotech Environmental water level meter. Potentiometric data were also monitored at selected wells using pressure transducer/data logger units. Personnel from Alton Coal Development (Kirk Nichols) assisted with water level measurements during the early period of the pumping test.

- Discharge rates were measured periodically during the test using a stop-watch and a calibrated container. Discharge temperature, specific conductance, and pH of the water pumped from CN3-81 and also the water in Kanab Creek adjacent to the pumping test area were also measured periodically during the test. Temperature measurements were performed using a Taylor brand electronic digital thermometer. Specific conductance measurements were performed using a Hanna Instruments brand, model HI 98311conductivity meter with automatic temperature compensation. The instrument was calibrated using traceable ASTM conductivity standard solutions. The pH measurements were performed using a Hanna Instruments brand, model HI 98128 pH meter, which incorporates a double junction pH electrode and automatic temperature compensation. The instrument was calibrated using traceable ASTM pH standard solutions.

- The pump test data were analyzed using the most current version of the program Aqtesolv (2007; version 4.50.002) from HydroSOLVE, Inc.

- Modeling of the alluvial groundwater system in the North Private Lease was performed using the program THWELLS (1996) and the aquifer parameters determined from the 2016 aquifer pump test. THWELLS is an analytical model from the International Ground Water Modeling Center that models flow in a confined, leaky confined, or unconfined aquifer. The program calculates the drawdown or buildup of piezometric head in an aquifer due to the combined effect of discharge or recharge of up to 100 wells. The calculations of total drawdowns in the North Private Lease were accomplished using the Hantush-Jacob equation for isotropic, homogeneous aquifer of infinite extent in a semi-confined (leaky) aquifer.

3.0 PRESENTATION OF DATA

The location of the North Private Lease area is shown on Figure 1. A geologic map of the North Private Lease area is presented in Figure 2. Also shown on Figure 2 are locations of monitoring wells and geologic borings in the North Private Lease area. Spatial drawdown information (maximum pumping drawdown) from the alluvial groundwater pumping test is also plotted on Figure 2. Construction details and locations for monitoring wells completed during the 2016 alluvial drilling program are provided in Table 1. A summary of the results of the 2016 aquifer pump test is provided in Table 2. Relationships between groundwater elevations in monitoring wells adjacent to Kanab Creek and surface waters in the creek are provided in Table 3. Discharge rate and water quality data from pumping well CN3-81 and Kanab Creek adjacent to the pump test area are provided in Table 3. Geologic logs for boreholes drilled during the 2016 alluvial drilling program are provided in Attachment A. Aquifer pump test information, including time-drawdown plots and tabulations of water level readings for the pumping and observation wells are provided in Attachment B. Details of the Aqtesolv pumping test analysis are provided in Attachment C. Photographs from the North Private Lease area are provided in the Photographs Section in Attachment D. Field and laboratory water quality measurements from selected 2016 monitoring wells in the North Private Lease area are provided in Attachment E.

4.0 Pump Test Results

The pump test information, including antecedent water level trend data, water level observation data collected during the pumping and recovery periods, and pumping rate data were compiled and graphed for analysis (see Attachments B and C). Pertinent data were then analyzed using Aqtesolv software. During the Aqtesolv analysis, the water level time drawdown data were graphed using a log-log plot. The character of the drawdown and recovery curves were compared to typical diagnostic plots for groundwater systems existing under differing aquifer regimes. During the Aqtesolv analysis, it was apparent that the data best fit the type curves for a "leaky" or semi-confined groundwater system. This observation is consistent with the field observations of conditions in the groundwater system (i.e. a sequence of partially saturated, lower-permeability interbedded clays, silts, and sands overlying the generally coarser gravel-bearing system. Using the parameters and assumptions shown in Attachment C, aquifer parameters were determined as shown on Table 2. It is noteworthy that the value of hydraulic conductivity determined in this test (5.88×10^{-3} cm/sec) is of similar magnitude to the value previously obtained by Utah International during testing at nearby well Y-103 (8.99×10^{-3} cm/sec).

An additional purpose of the pump test was to determine whether there is hydraulic communication between the various portions of the gravel-bearing zone in the North Private Lease area. It was noteworthy that a rapid response to the pumping at well CN3-81 was identified at well CN4-49 (more than 1.4 feet of drawdown), which is located 508 feet east of CN3-81 on the opposite side of Kanab Creek. It was also notable that a small but apparently related response to the pumping at CN3-81 was observed at well CN1-58, which is located 1,150 feet north of pumping well CN3-81. The muted response at this well apparently commenced after only a few minutes of pumping. It should be noted that at some of the more distant observation wells there were minor observable changes in water levels over time during the pump test, but the changes did not appear to be related to pumping at CN3-81. Rather, these changes appeared to more likely be associated with natural variability in water levels that occurred independent of the pumping (see Attachment B).

The hydraulic gradient measured in the vicinity of the pumping well prior to the start of the pump test was relatively flat (0.004) with a flow direction toward the east south-east.

It should be noted that the field water quality parameters (temperature, pH, and specific conductance) were monitored in the pumped groundwater periodically during the pump test. Pumping rates at CN3-81 were also monitored during the test (Table 4). These parameters did not change appreciably during the test. Field water quality parameters were also measured in Kanab Creek during the pump test (Table 4). The field water quality parameters measured in these two locations (alluvial groundwater at CN3-81 and Kanab Creek) are substantially different from each other. No trends in field water quality parameters were identified in groundwater from CN3-81 that would suggest a changing source of water over time during the test.

5.0 Groundwater Modeling

Groundwater modeling in the North Private Lease area was performed as part of this investigation to evaluate the relationship between groundwater withdrawals (and potentially groundwater injection) and changes to the hydraulic head in the alluvial groundwater system in and adjacent to proposed mining areas.

The data used in the groundwater modeling activities include information on the aquifer properties (water levels and subsurface stratigraphy) gained during the 2016 drilling and monitoring well installation program and also from several previous drilling activities in the North Private Lease area, and information regarding the aquifer characteristics (transmissivity, storage coefficient, etc.) determined from the 2016 aquifer pump test.

The THWELLS (1996) analytical groundwater modeling program, which supports the analysis of groundwater systems existing under semi-confined (leaky) groundwater conditions using the Hantush-Jacob equation, was selected for use in this groundwater modeling investigation.

The areas of focus for the groundwater modeling activities presented in this report include regions where proposed surface mining pits will be created in proximity to Kanab Creek and its associated alluvial groundwater systems. Generally, the sediments encountered in regions of the North Private Lease area that are more distant from Kanab Creek have been found to consist primarily of lower permeability clays, silts, and sands. Large groundwater flows are not anticipated to occur where these types of sediments dominate in mining areas. It should be noted that the THWELLS model used in this investigation can be utilized in the future to evaluate groundwater systems and proposed mining-related activities in other portions of the mine area as necessary.

Modeling of potential stream depletion was not performed as part of this investigation because the results of the 2016 pump testing did not indicate a strong hydraulic connection between the gravel-bearing alluvial groundwater system and the Kanab Creek surface water system in the proximity of the aquifer testing location.

In order to evaluate the relationship between potential groundwater withdrawals in the vicinity of the easternmost mine pit areas west of Kanab Creek (CN3-81 area), a series of three modeling simulations was performed. The results of modeling of these groundwater extraction scenarios are shown graphically on Figures 3, 4, and 5 and summarized in Attachment F. In each scenario, groundwater is extracted from the alluvial groundwater system using a series of eleven hypothetical production wells oriented in a north-south orientation and spaced 100 feet apart. The groundwater extraction simulated in these modeling scenarios could represent a north-south trending surface mining pit 1,000 feet in length into which groundwater flows, or a north-south oriented 1,000-foot array of wells from which groundwater is pumped from the alluvial aquifer at the specified rate.

In the first modeled scenario, groundwater is produced at a constant rate of 30 gpm from each of the 11 wells for a combined extraction rate of 330 gpm (0.74 cfs). For the second simulation, the extraction rate for each well was increased to 50 gpm, for a combined extraction rate of 550 gpm (1.26 cfs). For the third simulation, the extraction rate for each well was increased to 75 gpm, for a combined extraction rate of 825 gpm (1.84 cfs). In each scenario, the pumping time was set at 10 days. However, it was apparent during the modeling sensitivity studies performed as part of this study that the water level drawdowns reached approximate stabilization in less than 1 day.

From these scenarios it is apparent that appreciable drawdown of the alluvial aquifer can likely occur under even moderate pumping rates. Under scenario 1, pumping the eleven wells at a rate of 30 gpm each produced a rapid drawdown of more than 20 feet in a zone that is up to approximately 450 feet wide along the 1,000-foot long, north-south trending line of wells. Also under scenario 1, a zone of drawdown greater than 30 feet is present that is about 75 feet wide (Figure 3). Under the second scenario, a zone of groundwater drawdown greater than 30 feet is present that is up to about 500 feet wide, with a zone of drawdown greater than 40 feet that is about 200 feet wide (Figure 4). Under scenario 3, a zone of drawdown of more than 50 feet is projected in an area that is up to more than 400 feet wide (Figure 5).

It should be noted that per the Utah R645 mining rules and the proposed mining plan for the North Private Lease, backfilling of mine pit areas will be constantly occurring as mining progresses. For these reasons, the typical maximum expected length of open highwall along the eastern margin of the pit would be on the order of two pits, or around 450-600 feet, which is on the order of half the length of the simulated groundwater extraction areas modeled in the three scenarios discussed above.

These simulations demonstrate that extraction of groundwater from the gravel-bearing alluvial groundwater systems near Kanab Creek can produce appreciable drawdowns in the aquifer (such extractions could be associated with mine dewatering and/or gravity inflow of groundwater into the mine pits in the North Private Lease area).

Gravity groundwater drainage to mine pit areas

The general magnitude of gravity groundwater drainage into the mine pit area can be projected using Darcy's Law which is given as:

$$Q=KIA$$

Where "Q" is the discharge, "K" is the hydraulic conductivity, and "I" is the hydraulic gradient. Based on this equation, the projected discharge into the mine pit areas from the gravel-bearing alluvial zone (per 100 linear feet of exposed highwall with a 40 foot saturated thickness) may be calculated using values for these parameters as determined during the 2016 drilling, monitoring well installation, and pump testing programs as follows:

- K = 16.67 ft/day (Measured in the gravel-bearing zone near well CN3-81 during 2016 aquifer testing).
- I = 0.10 (It is noted that the hydraulic gradient in the undisturbed system measured in May 2016 was much (25 times) lower at 0.004, but the local gradient near the proposed mine highwall areas is expected to increase appreciably with a corresponding initial surge of groundwater when the gravel-bearing zone is first exposed in the mine pit highwalls. Therefore, the conservative value of 0.10 has been utilized in this evaluation. Over the longer term, the hydraulic gradients in more distant portions of the alluvial aquifer away from the proposed mine pit areas [that would be the source of potential ongoing groundwater inflow to the mine pits over longer periods of time] – would likely be lower, likely resulting in lower groundwater inflow rates over time).
- A = 400 ft^2 (100 linear feet of highwall length multiplied by thickness of the gravel-bearing zone in easternmost highwall area [CN3-81 area] of about 40 feet).

Thus, using these assumptions, a discharge (Q) of 6667 ft^3/day or 35 gpm per 100 linear feet of exposed highwall is projected. Note that if a lower hydraulic gradient was present, the calculated discharge into the pits would be proportionally lower (i.e. a gradient of 0.01 would yield a flow of one-tenth that predicted for a gradient of 0.10). It is anticipated that in areas outside the gravel-bearing alluvial zone, where lower permeability sediments dominate, inflows to the mine pits will likely be less than the amount in areas where the gravel-bearing zone is exposed.

It is important to note that Darcy's Law is directly applicable where there is constant flow in a confined, homogeneous aquifer of uniform thickness. In the North Private Lease area, the gravel-bearing alluvial zone is known to be variable in thickness, lithologic character, and spatial extent. For these reasons, the magnitude of the groundwater inflow projected above should be considered approximate – as based on the best information available at the time of this investigation.

If water were allowed to flow into the mine pits at large flow rates for a prolonged time, it is likely that the amount of groundwater extracted could become large relative to the amount of groundwater locally held in storage in the groundwater system, resulting in decreased hydraulic heads and possibly saturated thicknesses in the vicinity of the mine. However, the mine plan for the North Private Lease does not anticipate individual pits being left open for long periods of time and thus, this occurrence is not anticipated.

6.0 Observations

During drilling activities in the North Private Lease area, two principle hydrostratigraphic zones were identified in the alluvial system. The upper stratigraphy commonly exists primarily of interbedded clays, silts, and sands with caliche being present in some locations in the shallow subsurface. In areas where it is present, a gravel-bearing zone of fluvial origin was identified beneath the finer-grained overlying sediments. The gravel-bearing zone was identified previously during drilling activities by Utah International (1987) during the drilling of monitoring well Y-101. The approximate extent of this gravel-bearing zone as identified in available borehole data is shown on Figure 2. It is apparent that the gravel-bearing zone is generally situated near the present location of Kanab Creek and pinches out to the west (and likely also to the east). It should be noted that based on the drilling technique utilized (mud rotary), it is sometimes difficult to discriminate between a relatively clean gravel deposit and one in which the gravel is supported in a matrix of finer grained deposits (i.e. sands, silts, and clays). This is because the cuttings from the finer-grained deposits are commonly mixed in with the circulating drilling mud during drilling, which can make these fractions difficult to identify and quantify in the drill cutting returns. Additionally, larger clasts of gravel or boulders are commonly ground up during the rotary drilling operations making the identification of the presence of these larger rocks in the subsurface difficult. Accordingly, the gravel-bearing zone should be considered a zone in which a substantial portion of the material present is comprised of gravel – with varying (but not quantified) proportions of intermixed finer-grained deposits. It is noted that attempts were made to drill through the alluvial deposits at the North Private Lease using only air, or only water with little drilling mud, but these attempts were unsuccessful.

As noted in Table 2, the hydraulic conductivity of the gravel-bearing hydrostratigraphic unit as determined from the 2016 pumping test (16.67 ft/day or 5.88×10^{-3} cm/sec) is in the range of a typical clean sand or the upper range of silty sand (Freeze and Cherry, 1979). This finding would suggest that the gravels present in the gravel-bearing zone are likely supported in a matrix of finer grained deposits (sands or silty sands). This conclusion is consistent with field observations of the gravel deposits present in the stream banks adjacent to Kanab Creek in the pump test area (see Photographs Section Attachment D). It is notable that where observable in these locations the gravel and boulder clasts are generally supported in a matrix of finer-grained silts, sands, and clays.

It is noted that a marked and rapid response in water levels measured in well CN4-49 occurred during the pumping test in response to pumping at CN3-81, with drawdowns of up to 1.41 feet (Attachment B). No similar characteristic response to the pumping was identified in monitoring well NLP-4, which is screened in the stream gravels immediately adjacent to Kanab Creek. This observation is supportive of the conclusion that the groundwater in the deeper alluvial gravel-bearing zone exists under semi-confined conditions and that the gravel-bearing zone is not in strong, immediate hydraulic communication with surface waters in Kanab Creek. If this were the case, it would be anticipated that appreciable groundwater drawdowns would not be noted on the other side of the creek because surface waters would recharge the zone and prevent appreciable drawdowns on the other side of the creek from occurring (i.e. a constant head boundary).

Observations of water levels in monitoring wells NLP-4, NLP-5, and NLP-11 relative to surface water levels in Kanab Creek at adjacent locations are also supportive of the conclusion that Kanab Creek is not in strong, immediate hydraulic communication with the deeper gravel-bearing horizon in those locations. As noted in Table 5, water levels in those monitoring wells are lower at each location than the local elevation of the Kanab Creek water surface (with differences ranging from 1.48 to 3.08 feet). Notably at well locations NLP-4 and NLP-5 Kanab Creek is situated less than about 30 feet from the wells. This information suggests that Kanab Creek is at least somewhat perched above the alluvial groundwater system in which the monitoring wells are completed. The perched condition is likely attributable to the presence of interbedded low-permeability silty or clayey strata between the bottom of the creek bed and the underlying alluvial groundwater system. Visual observations also suggest the common presence of an apparent low-permeability skin on the Kanab Creek stream channel substrate. While rocks and boulders are commonly present in the stream channel, surrounding deposits of clays and silts are usually present in the channel bed and bank (see Photographs Section Attachment D), which may decrease the hydraulic connection with underlying groundwater alluvial sediments.

7.0 REFERENCES CITED

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Utah International, Inc., 1987, Mining and Reclamation Plan application submitted to the Utah Division of Oil, Gas and Mining, available for public review at the offices of the Division of Oil, Gas and Mining, 1594 W. North Temple, #1210, Salt Lake City, Utah.

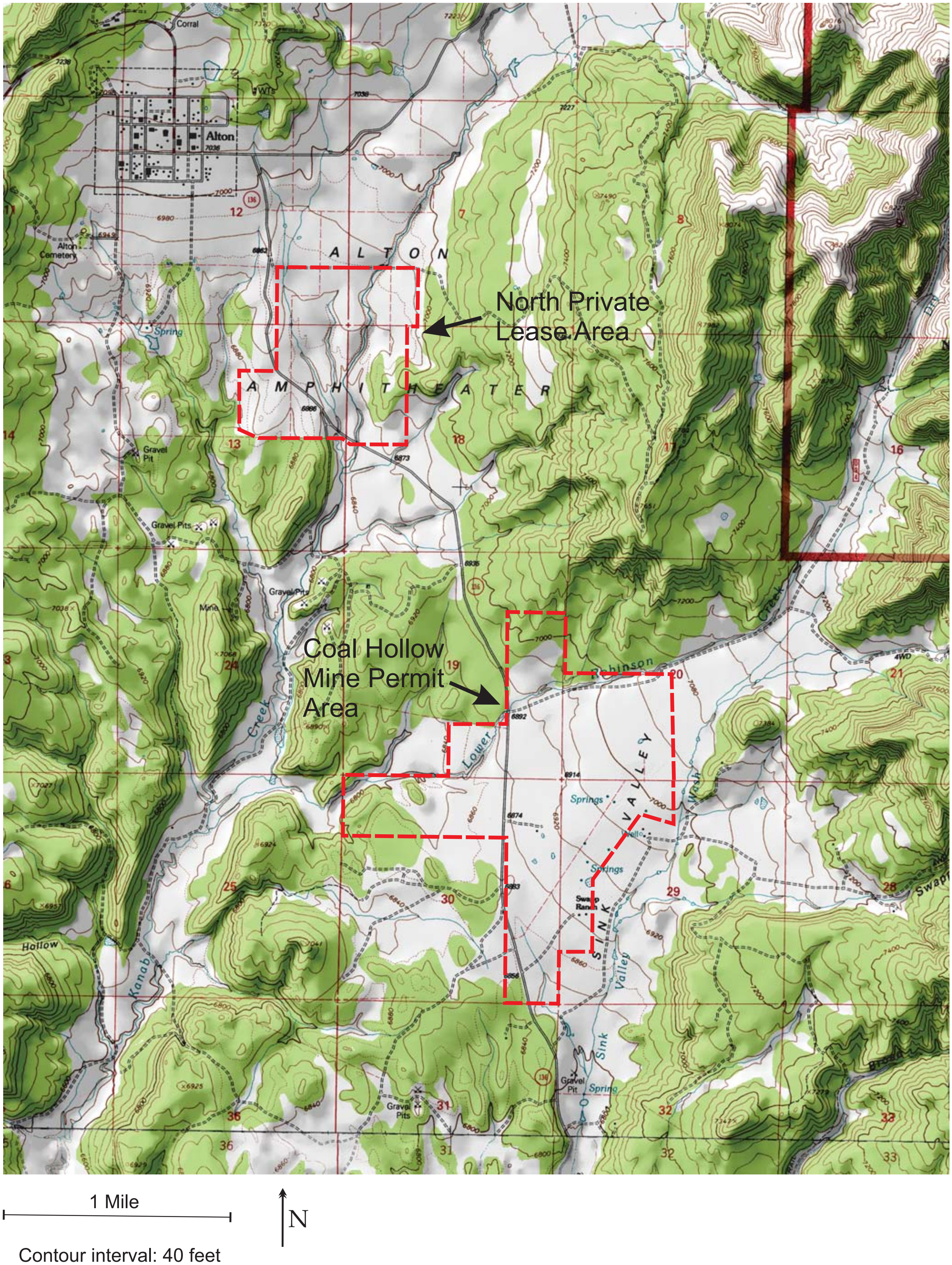


Figure 1 Location of the North Private Lease area at the Coal Hollow Mine.

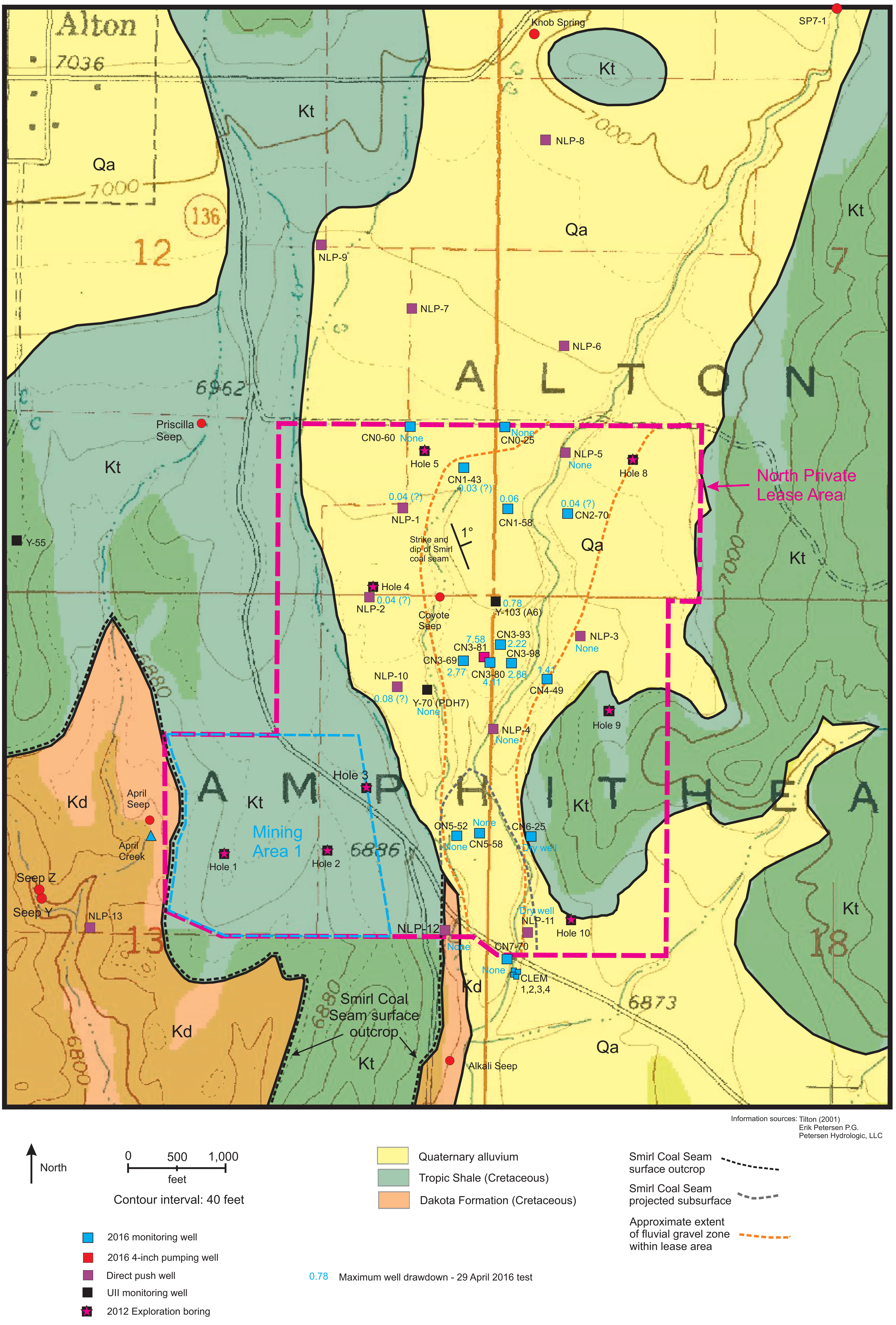
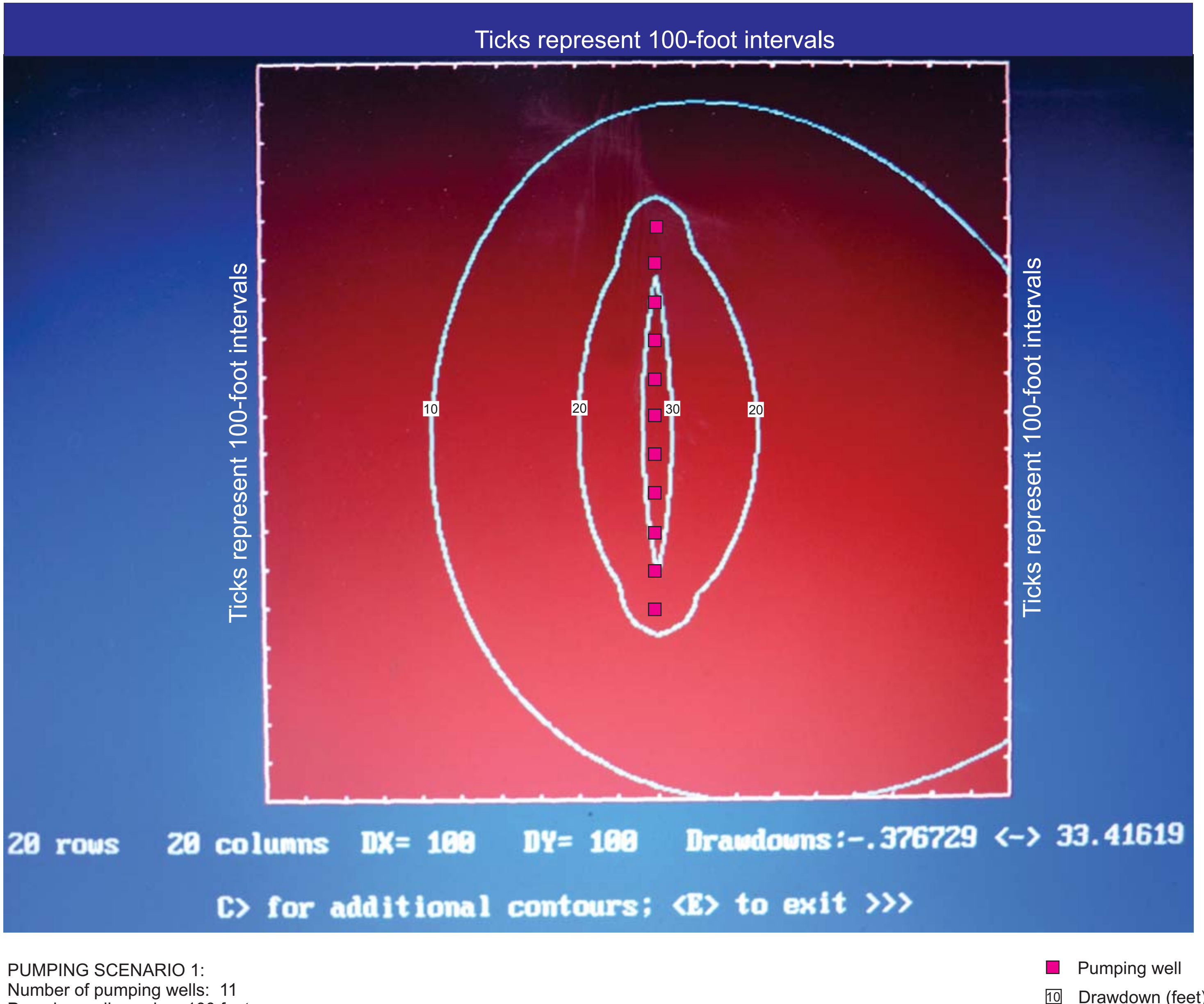
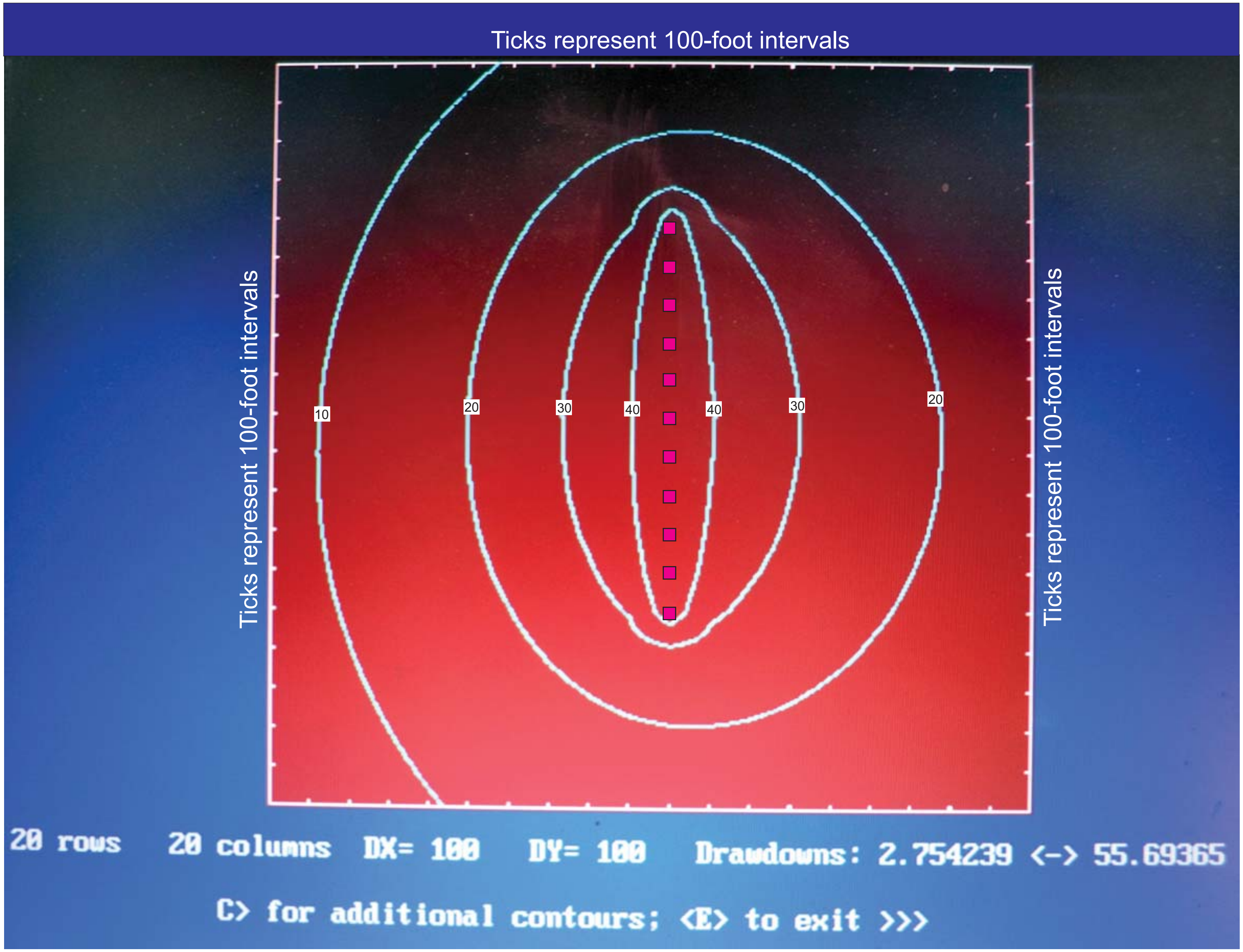


Figure 2 Geologic map of North Private Lease area with monitoring well and geologic boring locations. Also shown are maximum drawdowns from 2016 alluvial groundwater pump test.



PUMPING SCENARIO 1:
Number of pumping wells: 11
Pumping well spacing: 100 feet
Pumping rate: 30 gpm (per well)

Figure 3 Modeled alluvial aquifer drawdown under pumping scenario 1.



PUMPING SCENARIO 2:
Number of pumping wells: 11
Pumping well spacing: 100 feet
Pumping rate: 50 gpm (each well)

Pumping well
10 Drawdown (feet)

Figure 4 Modeled alluvial aquifer drawdown under pumping scenario 2.

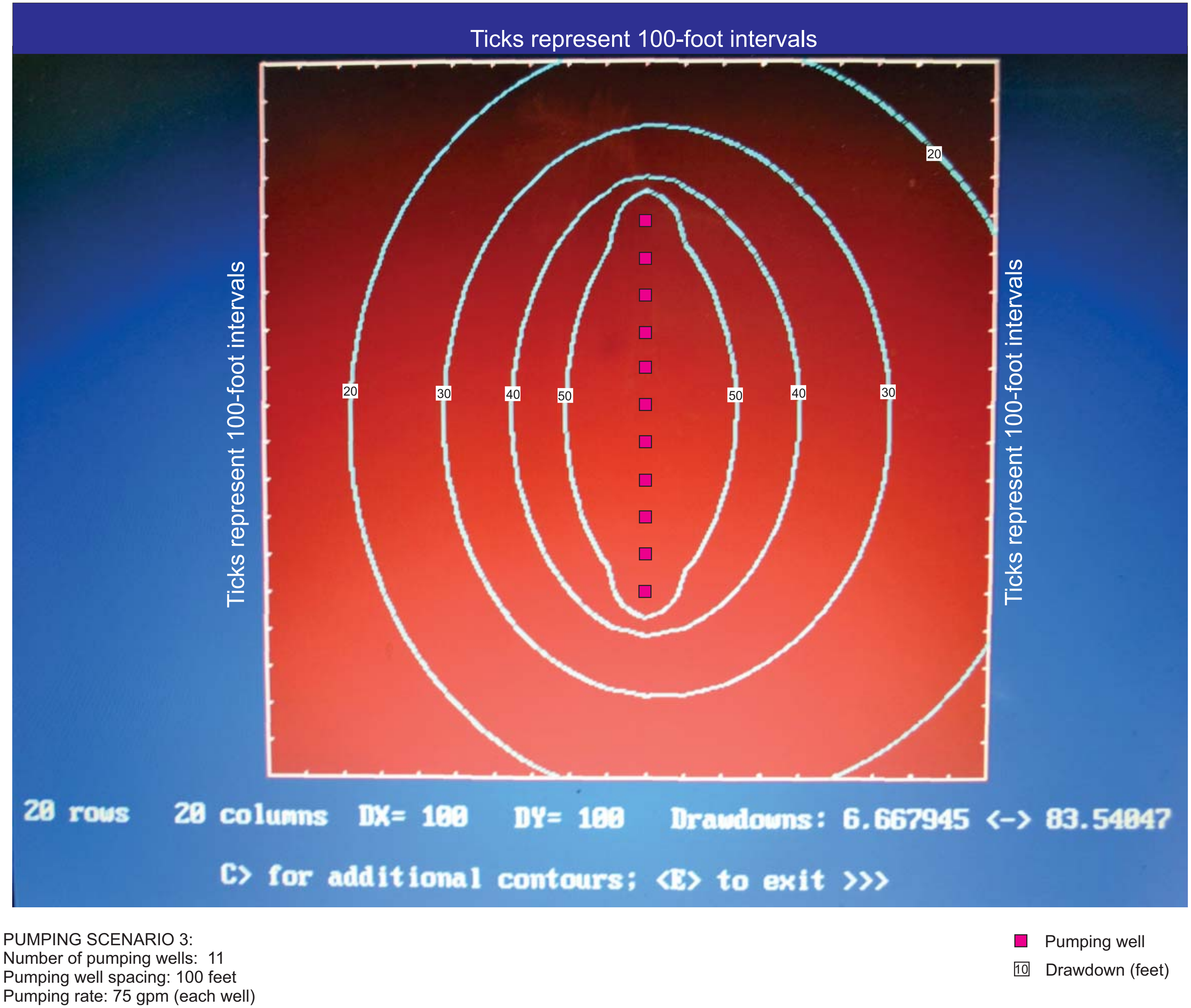


Figure 5 Modeled alluvial aquifer drawdown under pumping scenario 3.

Table 1 Construction details for for 2016 monitoring wells in the North Private Lease area.

Well ID	Alt. ID	Location UTM NAD 27 (Hand held GPS)		Date drilled	Borehole diameter	Drilling type	Total borehole depth (ft.)	Casing type	Bottom blank length (ft.)	Screen type	Screen length (ft.)	Screen diameter	Screen bottom (ft.)	Screen top (ft.)	Gravel type	Gravel bottom (ft.)	Gravel top (ft.)	Plug bottom (ft.)	Plug top (ft.)
CN0-60	CN0-1	370185	4143447	15-Mar-16	6.125-inch	mud rotary	86	2-inch sch 80	26	Hand slotted, 1/8 - inch slot	30	2-inch	60	30	pea gravel 3/8 -	86	30	30	0
CN0-25	CN0-2	369968	4143451	14-Mar-16	6.25-inch	mud rotary	56	2-inch sch 80	13	Hand slotted, 1/8 - inch slot	20	2-inch	25	15	pea gravel 3/8 -	56	15	15	0
CN1-58	CN1-1	370191	4143257	7-Mar-16	6.25-inch	mud rotary	68	2-inch sch 80	10	Hand slotted, 1/8 - inch slot	20	2-inch	58	38	pea gravel 3/8 -	68	34	34	0
CN1-43	CN1-2	370090	4143355	14-Mar-16	6.25-inch	mud rotary	56	2-inch sch 80	13	Hand slotted, 1/8 - inch slot	20	2-inch	43	23	pea gravel 3/8 -	43	22	22	0
CN2-70	CN2-1	370335	4143248	18-Mar-16	6.25-inch	mud rotary	115	2-inch sch 80	30	Hand slotted, 1/8 - inch slot	40	2-inch	70	30	pea gravel 3/8 -	100	29	20	0
CN3-98	CN3-1	370200	4142900	3-Mar-16	6.25-inch	mud rotary	108	2-inch sch 80	10	Hand slotted, 1/8 - inch slot	30	2-inch	98	68	pea gravel 3/8 -	98	42	42	0
CN3-69	CN3-2	370088	4142905	8-Mar-16	6.25-inch	mud rotary	83	2-inch sch 80	10	Hand slotted, 1/8 - inch slot	30	2-inch	69	39	pea gravel 3/8 -	79	38	38	0
CN3-80	CN3-3	370151	4142903	9-Mar-16	6.25-inch	mud rotary	83	2-inch sch 80	0	Hand slotted, 1/8 - inch slot	40	2-inch	80	40	pea gravel 3/8 -	80	39	39	0
CN3-93	CN3-4	370175	4142942	10-Mar-16	6.25-inch	mud rotary	108	2-inch sch 80	10	Hand slotted, 1/8 - inch slot	40	2-inch	93	53	pea gravel 3/8 -	93	52	52	0
CN3-81	CN3-5	370134	4142913	24-Mar-16	7.875-inch	mud rotary	84	4-inch sch 40	0	Hand slotted, 1/8 - inch slot	40	4-inch	81	41	pea gravel 3/8 -	81	40	40	0
CN4-49	CN4-1	370285	4142864	21-Mar-16	6.25-inch	mud rotary	59	2-inch sch 80	5	Hand slotted, 1/8 - inch slot	20	2-inch	49	29	pea gravel 3/8 -	59	25	25	0
CN5-58	CN5-1	370122	4142503	1-Mar-16	6.125-inch	mud rotary	63	2-inch sch 80	0	20 slot machine	30	2-inch	58	28	Pea gravel 3/8 -	58	28	28	0
CN5-52	CN5-2	370069	4142496	2-Mar-16	5.875-inch	mud rotary	63	2-inch sch 80	0	Hand slotted, 1/8 - inch slot	20	2-inch	52	32	Pea gravel 3/8 -	52	31	31	0
CN6-25	CN6-1	370250	4142495	22-Mar-16	6.25-inch	mud rotary	28	2-inch sch 80	3	Hand slotted, 1/8 - inch slot	15	2-inch	25	10	pea gravel 3/8 -	28	10	10	0
CN7-70	CN7-1	370184	4142207	16-Mar-16	6.25-inch	mud rotary	76	2-inch sch 80	0	Hand slotted, 1/8 - inch slot	30	2-inch	70	40	pea gravel 3/8 -	70	39	39	0
Clem 1	Hole 1	370214	4142181	14-Mar-16	6.25-inch	Direct push	32	1-inch pvc	0	Size 10 slot pvc	20	1-inch	28	8	10-20 Silica sand	28	6	6	0
Clem 2	Hole 2	370208	4142171	15-Mar-16	6.25-inch	Direct push	28	1-inch pvc	0	Size 10 slot pvc	20	1-inch	28	8	10-20 Silica sand	28	5	5	0
Clem 3	Hole 3	370200	4142177	15-Mar-16	6.25-inch	Direct push	28	1-inch pvc	0	Size 10 slot pvc	20	1-inch	27	7	10-20 Silica sand	27	5	5	0
Clem 4	Hole 4	370202	4142185	15-Mar-16	6.25-inch	Direct push	28	1-inch pvc	0	Size 10 slot pvc	20	1-inch	27.5	7.5	10-20 Silica sand	27.5	5	5	0

Table 2 Aquifer parameters determined in the 2016 pump test in the North Private Lease area.

(see Attachments A, B, and C for additional testing details)

Primary gravel-bearing zone (CN3-81 area)

Aquifer model: Leaky aquifer (semi-confined)
(pumping well with two observation wells)

Solution method: Hantush-Jacob

T = 667 ft^2/day
b = 40 feet
S = 1.599 x 10^{-4} (unitless parameter)
K = 16.67 ft/day
   = 5.881 x 10^{-3} cm/sec

Tropic Shale
Not sufficiently transmissive for testing (produced no water)
K = very low

Table 3 Kanab Creek surface water - alluvial groundwater relationships in North Private Lease area.

	Data collected on 31 May 2016			
	Stream water surface elevation adjacent to well (feet)	Groundwater elevation in monitoring well (feet)	Ground elevation at well location (feet)	Water elevation separation (feet)
NLP-4 area	6869.44	6867.96	6871	-1.48
NLP-5 area	6917.47	6914.39	6921	-3.08
NLP-11 area	6836.25	6833.39	6862	-2.86

Table 4 Discharge rate and water quality data from water pumped from CN3-81 and sampled from Kanab Creek during pumping test.

Date	Time	Q (gpm)	T (°C)	pH (S.U.)	Sp. conductance (µS/cm)
CN3-81 (pumping well)					
29-Mar-16	10:30	29.5	---	---	---
29-Mar-16	10:38	28.1	---	---	---
29-Mar-16	12:02	26.7	---	7.15	2,156
29-Mar-16	12:34	28.3	---	---	---
29-Mar-16	11:56	28.5	---	---	---
29-Mar-16	13:09	28.8	---	---	---
29-Mar-16	13:45	---	---	6.97	2,161
29-Mar-16	15:35	29.0	11.2	7.04	2,157
29-Mar-16	18:30	29.0	11.2	7.00	2,145
29-Mar-16	20:45	28.8	11.2	7.01	2,148
30-Apr-16	0:36	29.4	11.2	7.00	2,172
30-Apr-16	7:30	28.9	11.1	6.93	2,170
30-Apr-16	9:51	29.5	---	---	---
30-Apr-16	16:00	28.8	11.2	7.02	2,175
30-Apr-16	16:20	29.0	---	---	---
30-Apr-16	22:00	29.7	11.2	7.02	2,161
1-May-16	9:20	28.9	11.2	7.04	2,194
1-May-16	13:21	28.7	11.2	7.07	2,174
1-May-16	18:15	29.2	11.2	7.06	2,175
Kanab Creek at SW-4					
30-Apr-16	8:56	---	6.2	8.56	895
1-May-16	11:30	---	9	8.68	905

Attachment A

Geologic logs for 2016 boreholes

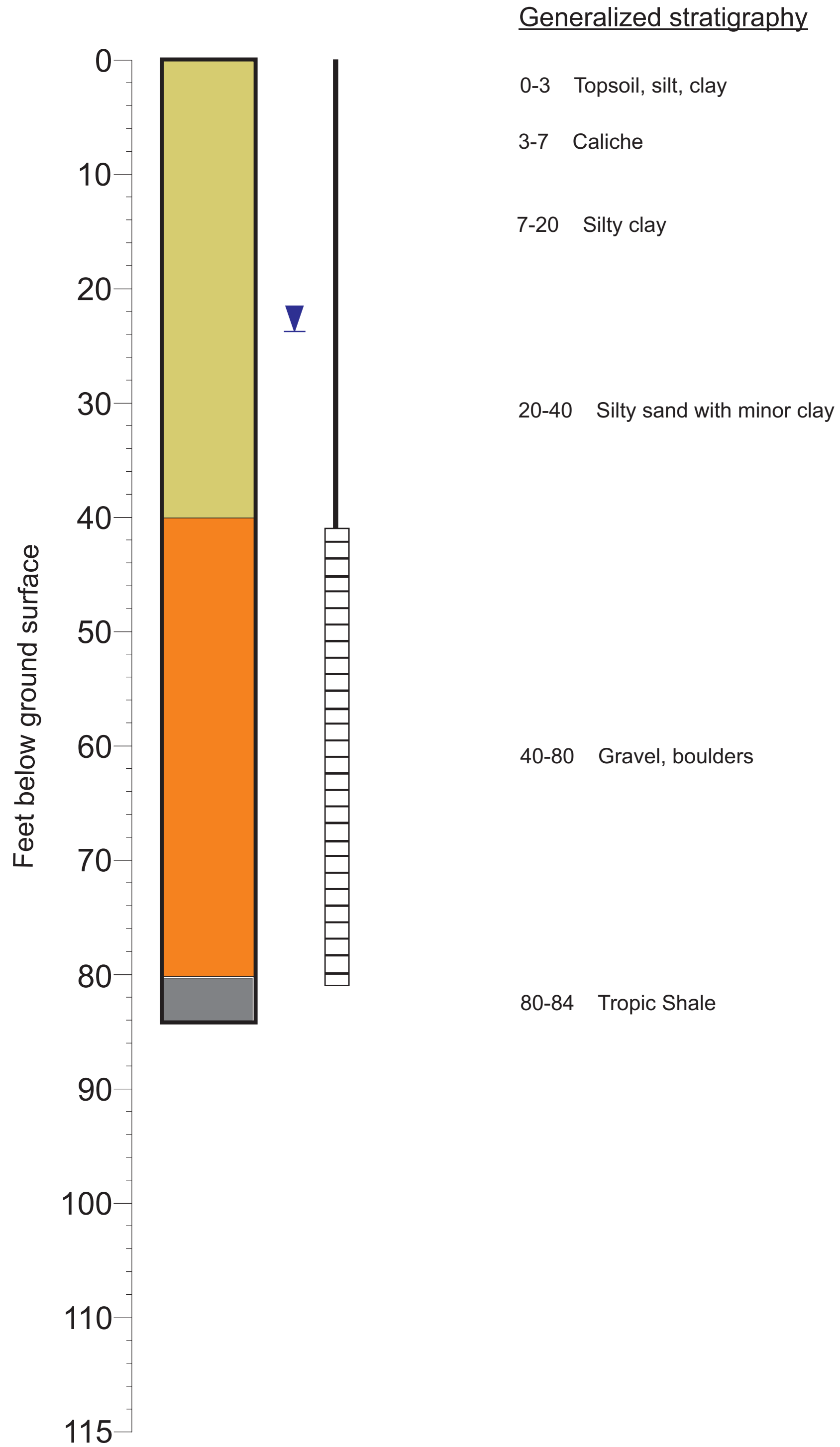
In the North Private Lease area

(and UII well Y-103)

(Listed in order of increasing distance from pumping well CN3-81)

Listing of 2016 Geologic Logs

Well ID
CN3-81
CN3-80
CN3-93
CN3-69
CN3-98
Y-103
CN4-49
CN1-58
CN2-70
CN5-58
CN5-52
CN1-43
CN0-25
CN0-60
CN7-70



Well ID: CN3-81 (CN3-5)

Location: 1764206, 364102 ft.
Collar elevation: 6910.80 ft.
Date constructed: 24 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

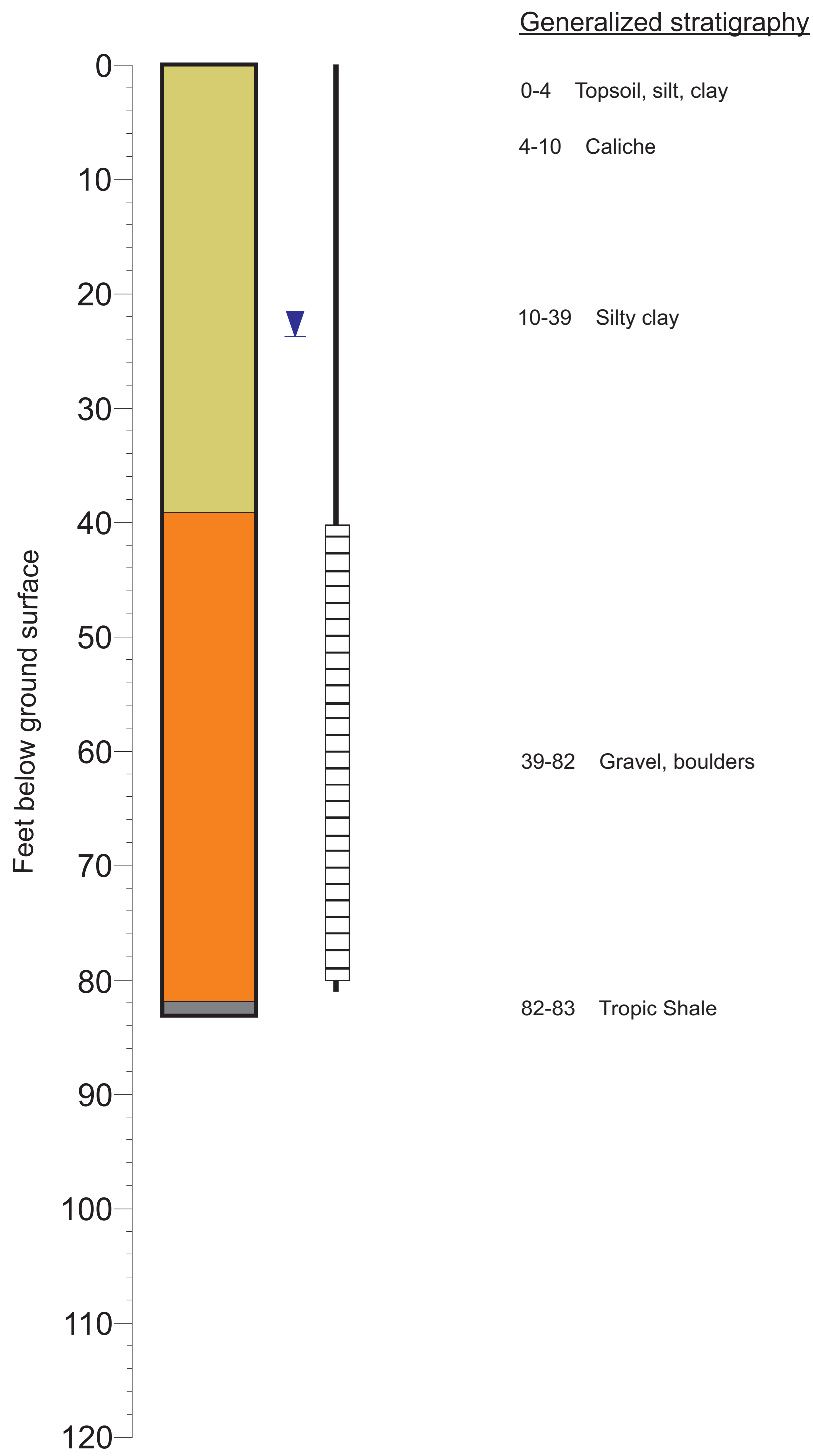
Drilling method: Mud rotary
Well screened interval: 41-81 ft.
Well casing diameter: 4-inch
Borehole diameter: 7.875-inch
Casing stick-up: 1.67 ft.

Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN3-80 (CN3-3)

Location: 1764246, 364066 ft.
Collar elevation: 6910.29 ft.
Date constructed: 9 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 40-80 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.67 ft.

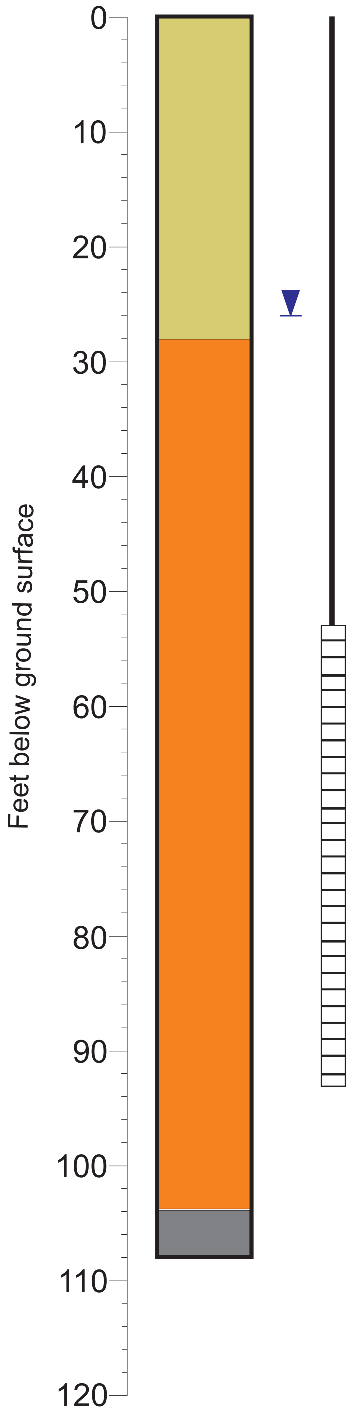
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



Generalized stratigraphy

0-3 Soil, clayey silt

3-7 Caliche

7-28 Clay, silty clay

28-74 Gravel

74-75 Clay

75-104 Gravel

104-108 Tropic Shale (top of coal at 108)

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN3-93 (CN3-4)

Location: 1764325, 364201 ft.
Collar elevation: 6912.34 ft.
Date constructed: 10 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 53-93 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.42 ft.

Screened interval

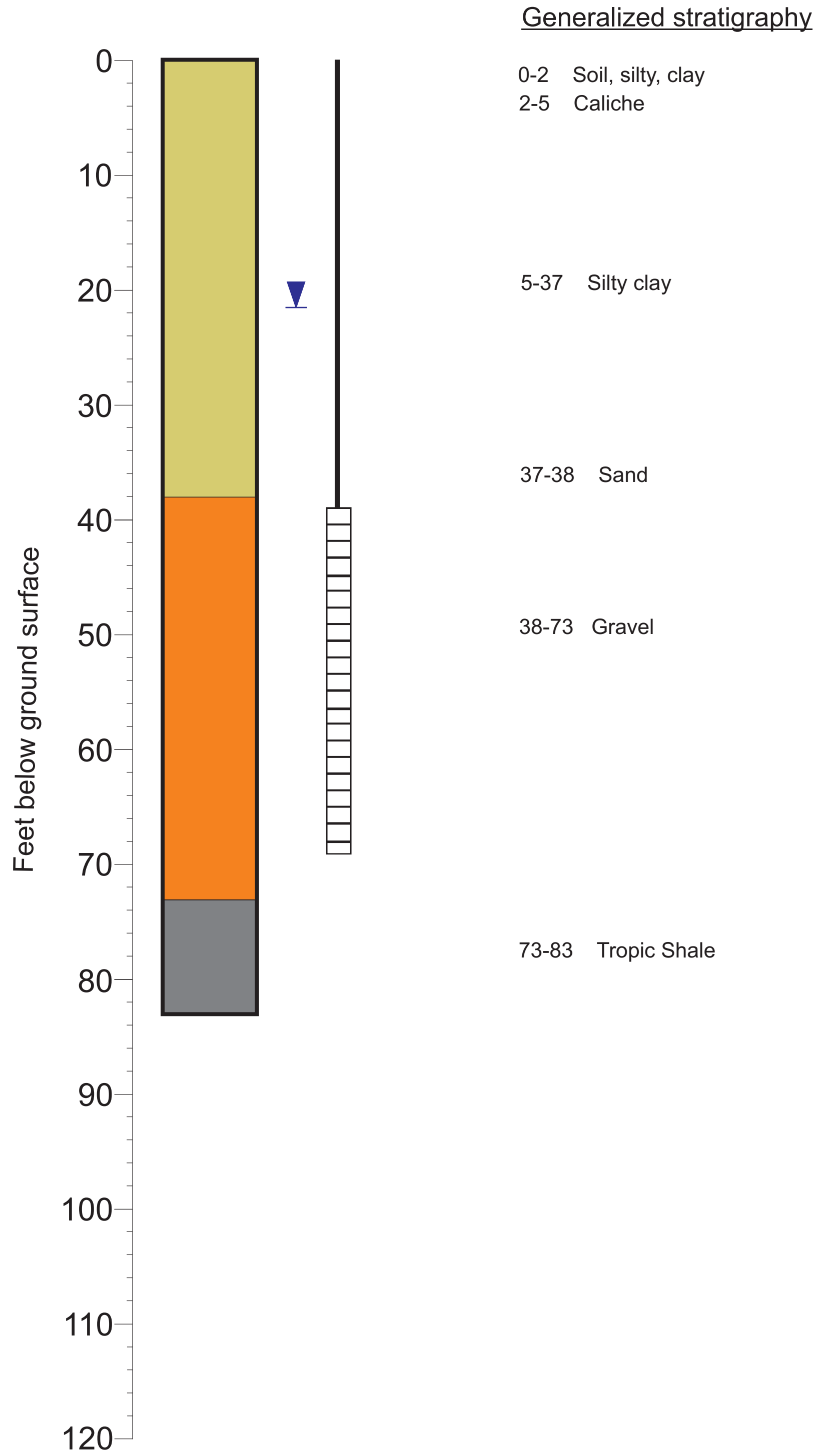
Hydrostratigraphic unit

- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN3-69 (CN3-2)

Location: 1764043, 364077 ft.
Collar elevation: 6907.54 ft.
Date constructed: 8 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 39-69 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 0.38 ft.

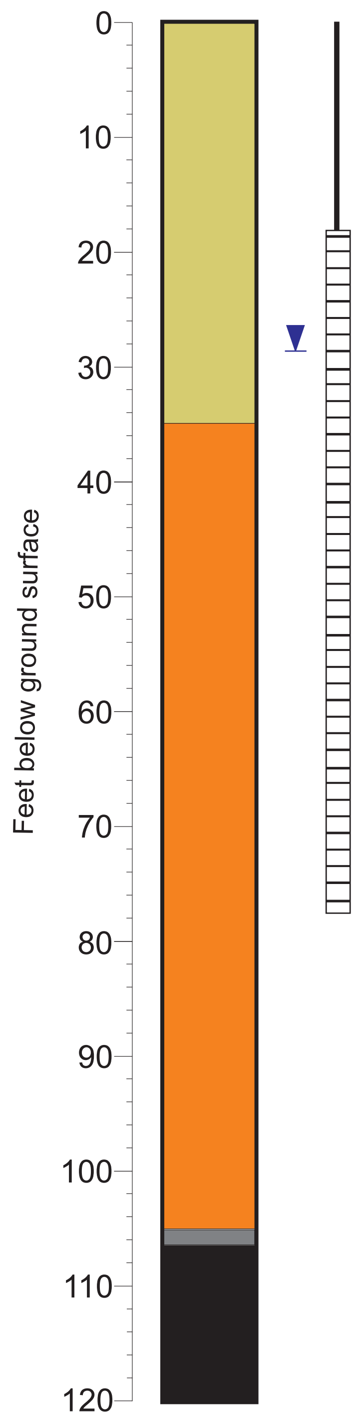
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



Generalized stratigraphy

0-10 Silt, clayey

10-15 Silty clay

15-35 Silty sand, clay

35-55 Gravel, sandy

55-75 Gravel

75-90 Sandy gravel

90-105 Gravel

105-106.5 Tropic Shale

106.5-120 Coal

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: Y-103 (A6)

Location:
Collar elevation: 6919.8 ft.
Date constructed: 7 Nov 1986
Drilled by: Jack
Logged by: J. Kiefer

Drilling method: Mud rotary
Well screened interval: 17.9-77.8 ft.
Well casing diameter: 2-inch
Borehole diameter: 8.875-inch
Casing stick-up: 2.9 ft.

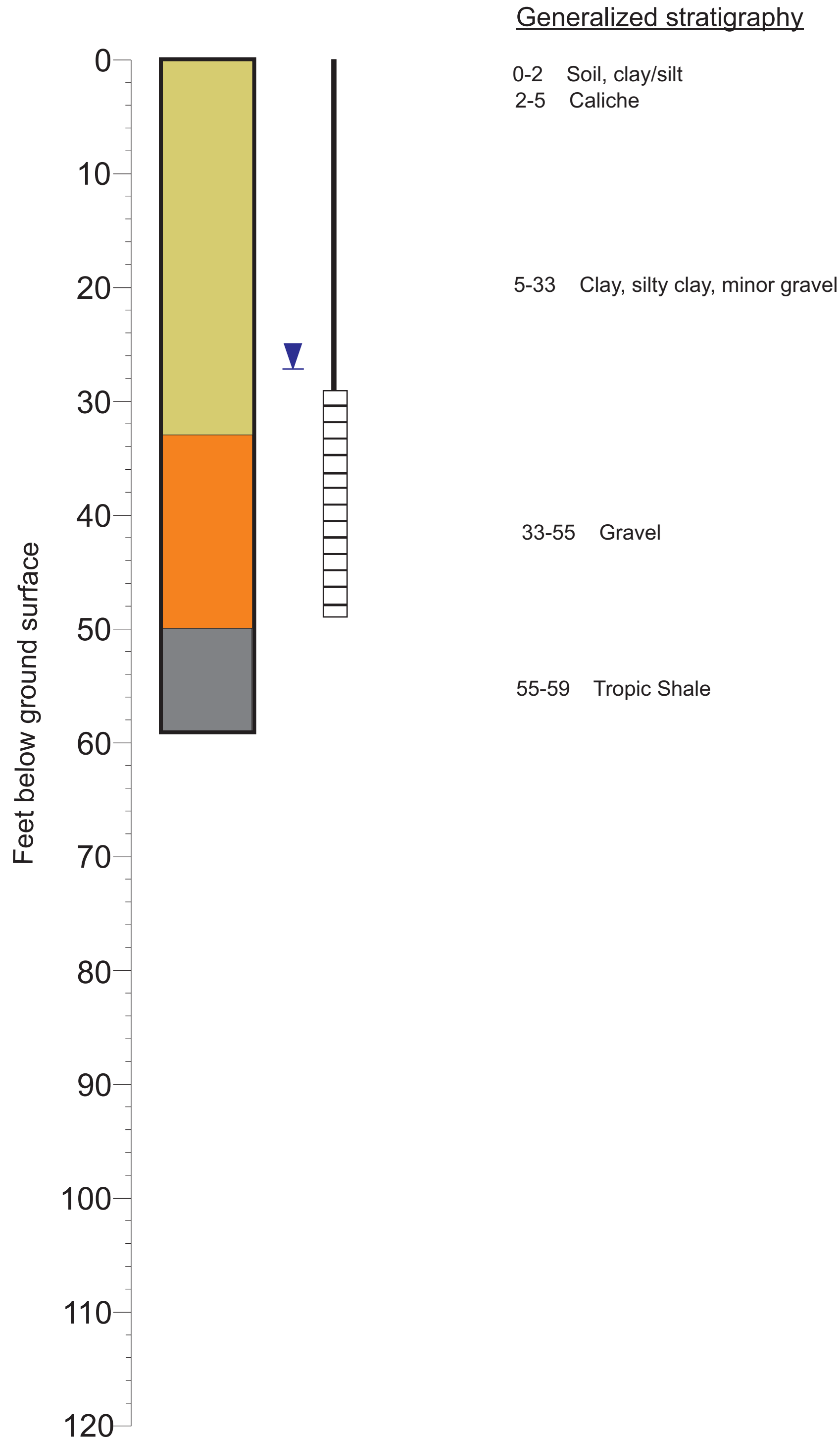
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN4-49 (CN4-1)

Location: 1764687, 363938 ft.
Collar elevation: 6912.09 ft.
Date constructed: 21 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 29-49 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.54 ft.

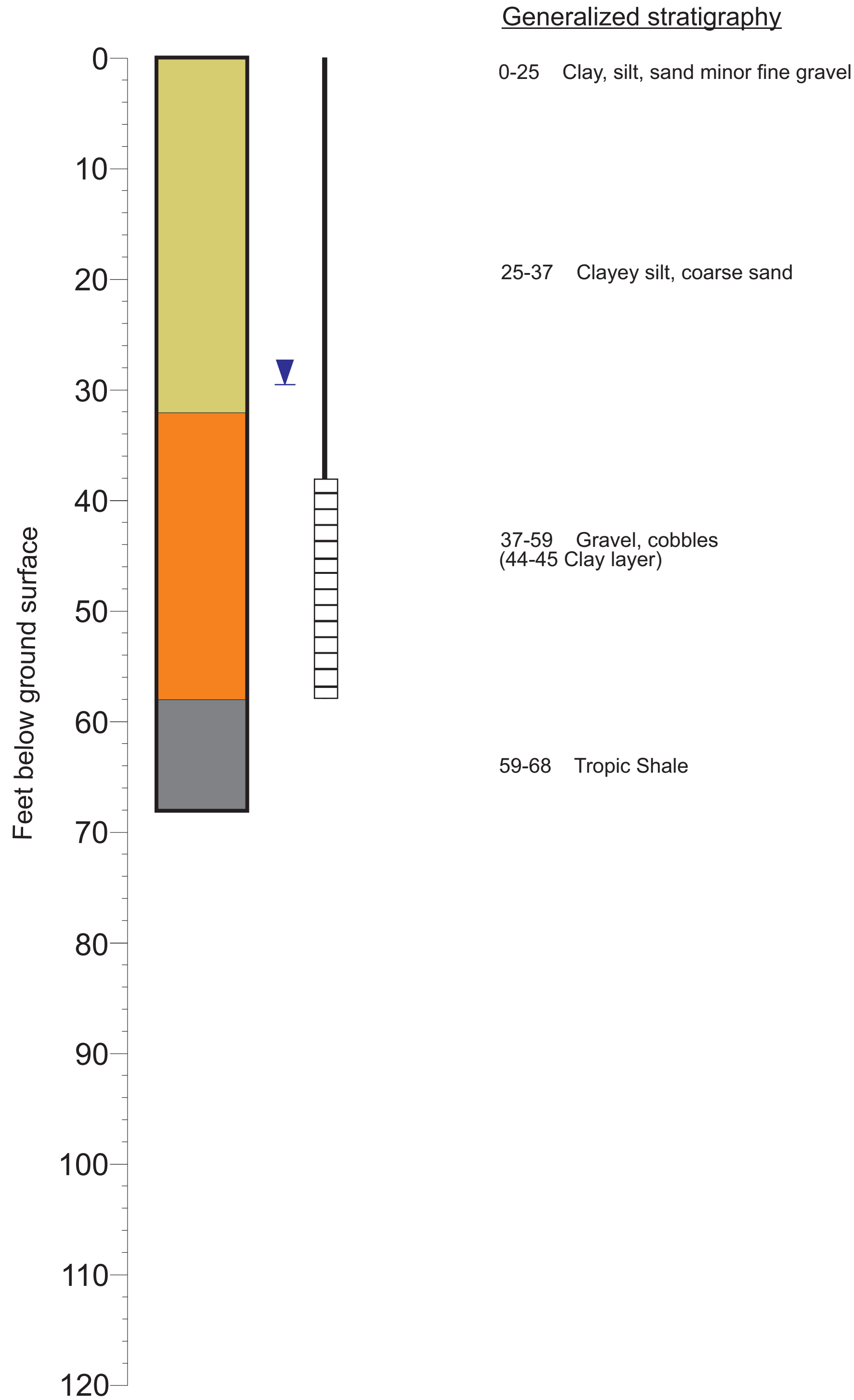
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN1-58 (CN1-1)

Location: 1764167, 362758 ft.
Collar elevation: 6878.10 ft.
Date constructed: 7 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 38-58 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.79 ft.

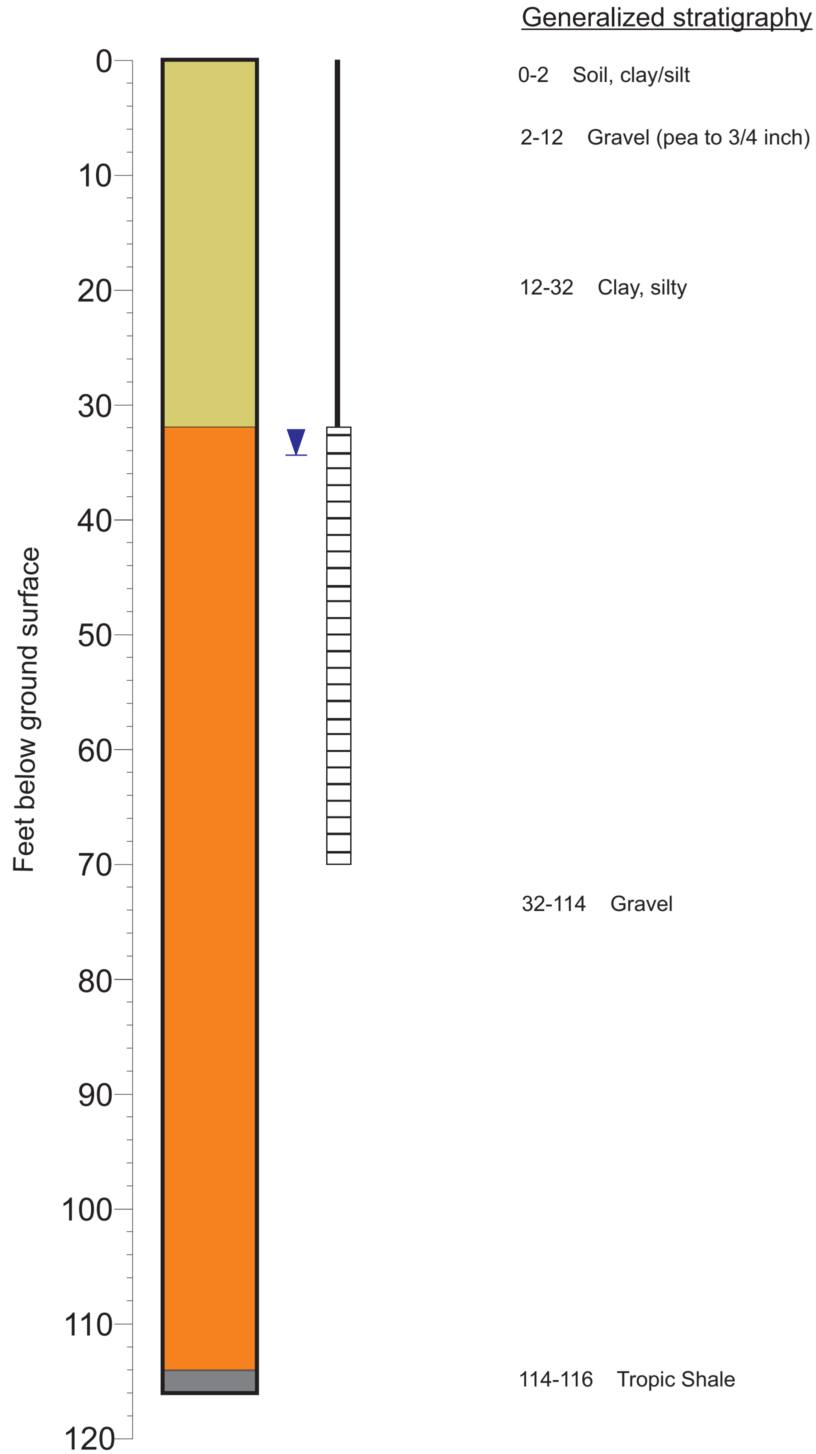
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN2-70 (CN2-1)

Location: 1764835, 365204 ft.
Collar elevation: 6937.37 ft.
Date constructed: 18 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 30-70 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.33 ft.

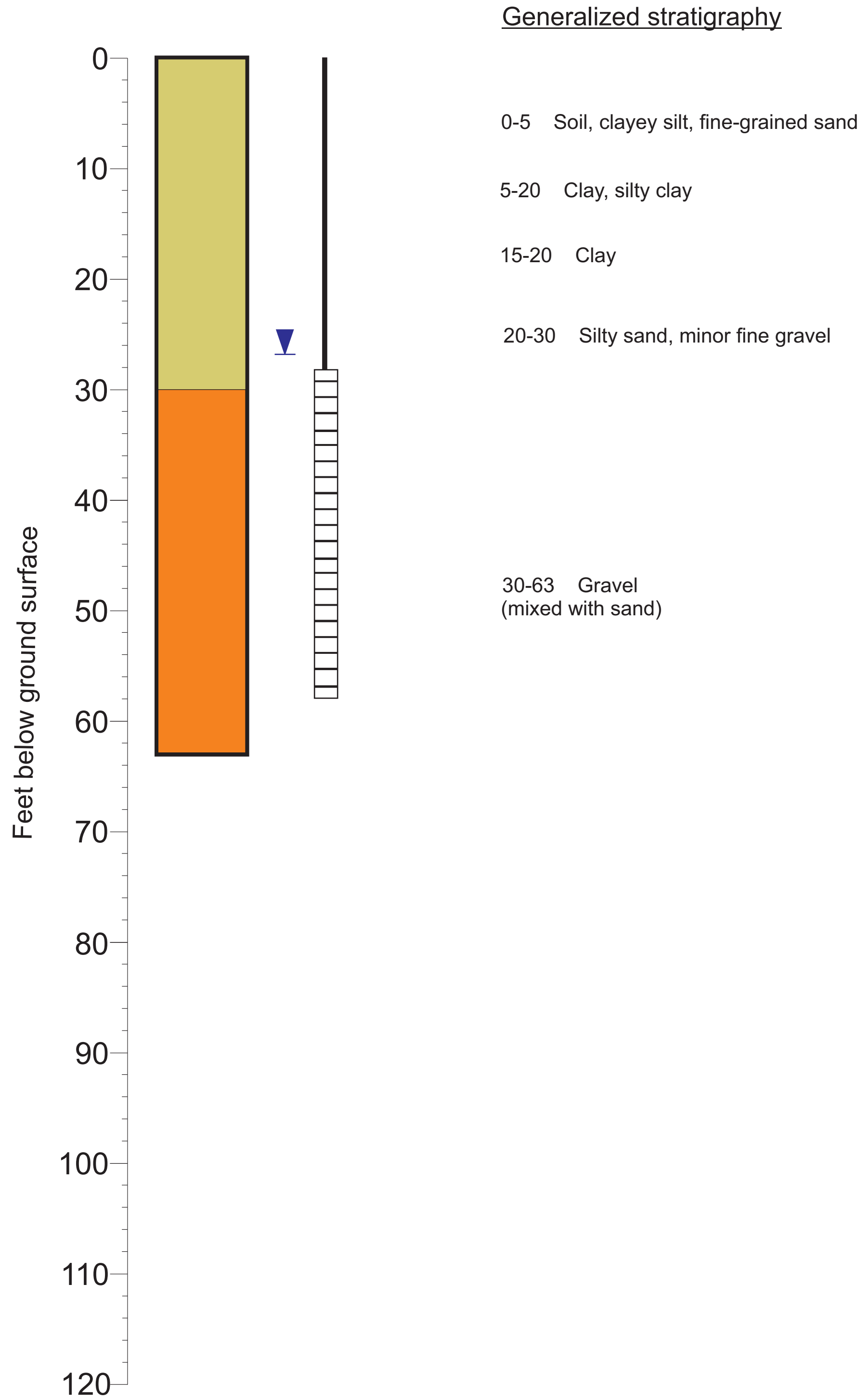
Screened interval

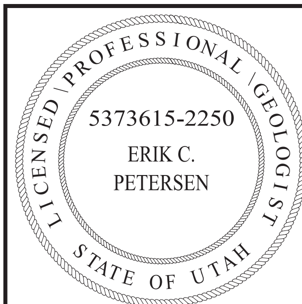
Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine





Well ID: CN5-58 (CN5-1)

Location: 1764167, 362758 ft.
Collar elevation: 6878.10 ft.
Date constructed: 1 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 28-58 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.79 ft.

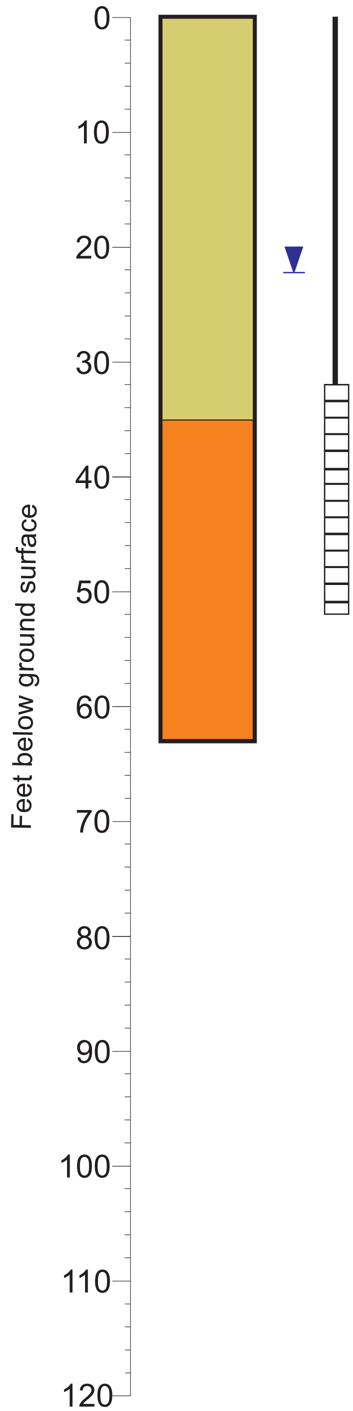
Screened interval

Hydrostratigraphic unit

- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Alton Coal Development, LLC
Coal Hollow Mine



Generalized stratigraphy

0-13 Silty clay

13-22 Sand, clay, minor silt

22-25 Fine gravel (3/16 inch), clay

25-35 Fine gravel (3/16 inch), silty fine-grained sand

35-63 Gravel
(mixed with sand)

(Gravel becoming coarser at 42 feet)

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN5-52 (CN5-2)

Location: 1763994, 362738 ft.
Collar elevation: 6875.40 ft.
Date constructed: 2 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 32-52 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 2.38 ft.

Screened interval

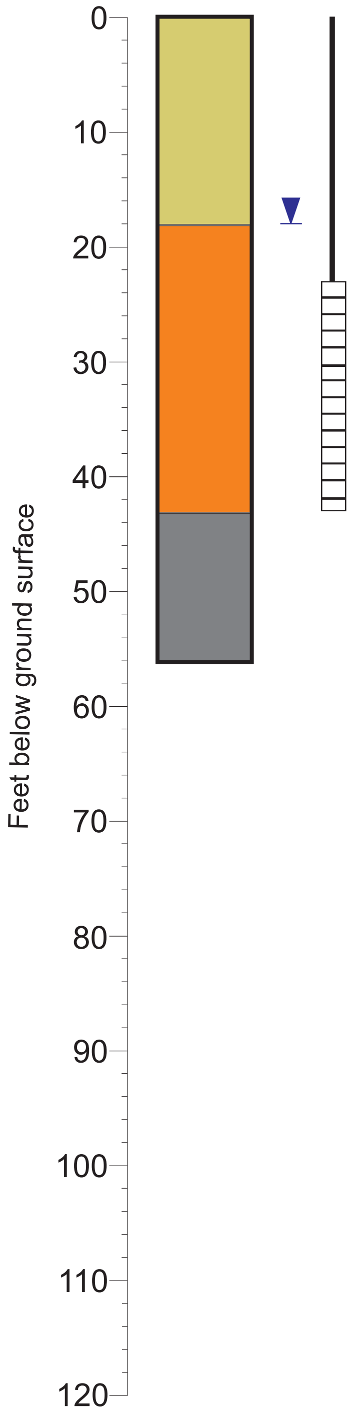
Hydrostratigraphic unit

- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



Generalized stratigraphy

0-2 Soil, clay/silt

2-18 Silty clay

18-43 Gravel

43-51 Silty clay (weathered Tropic Shale)

51-56 Tropic Shale

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN1-43 (CN1-2)

Location: 1764041, 365553 ft.
Collar elevation: 6931.16 ft.
Date constructed: 14 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 23-43 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 0.86 ft.

Screened interval

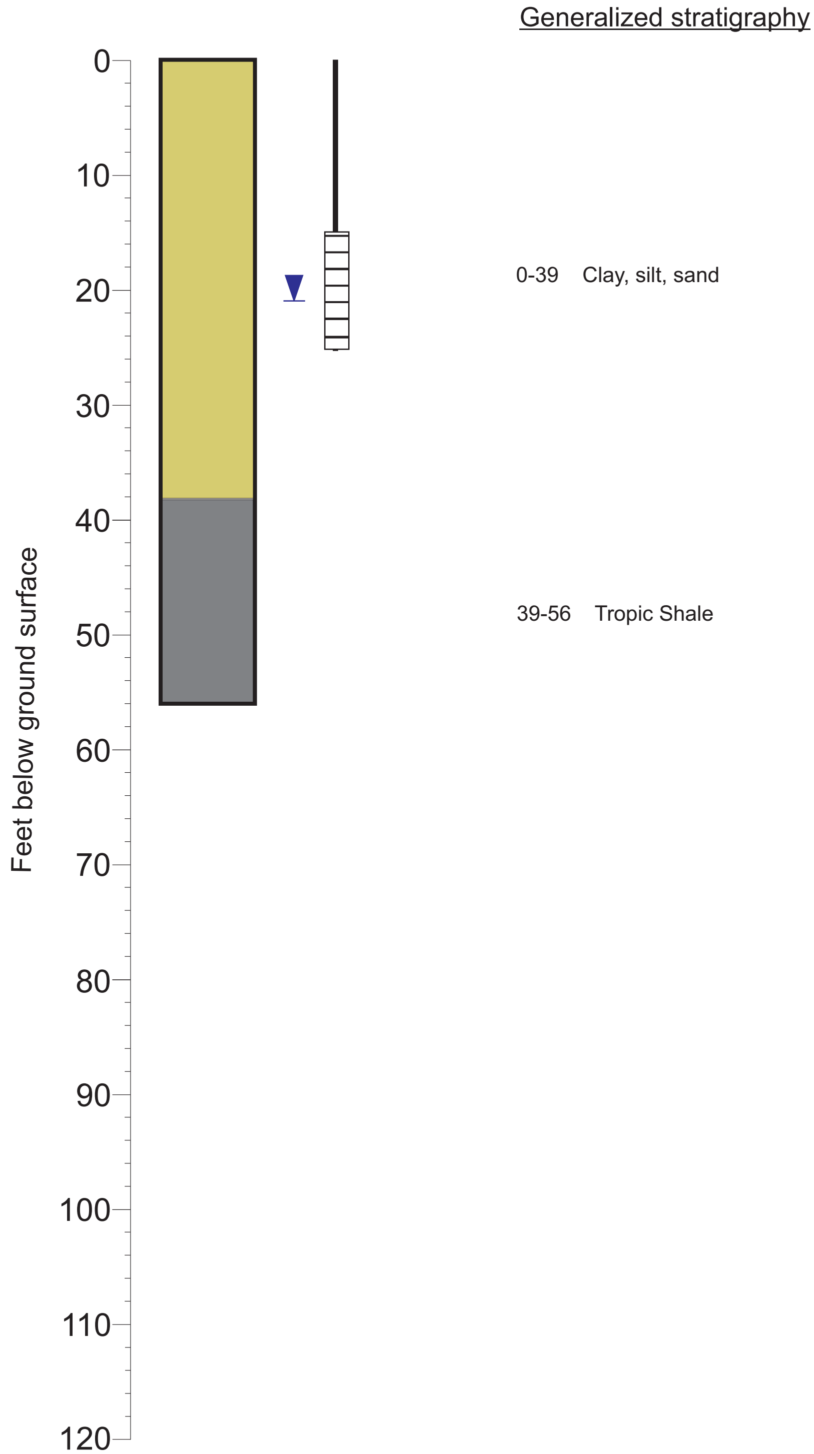
Hydrostratigraphic unit

Clay/silt/sand
Gravel (mixed matrix)
Tropic Shale
Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine



LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN0-25 (CN0-2)

Location: 1764358, 365869 ft.
Collar elevation: 6939.28 ft.
Date constructed: 14 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 15-25 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 0.83 ft.

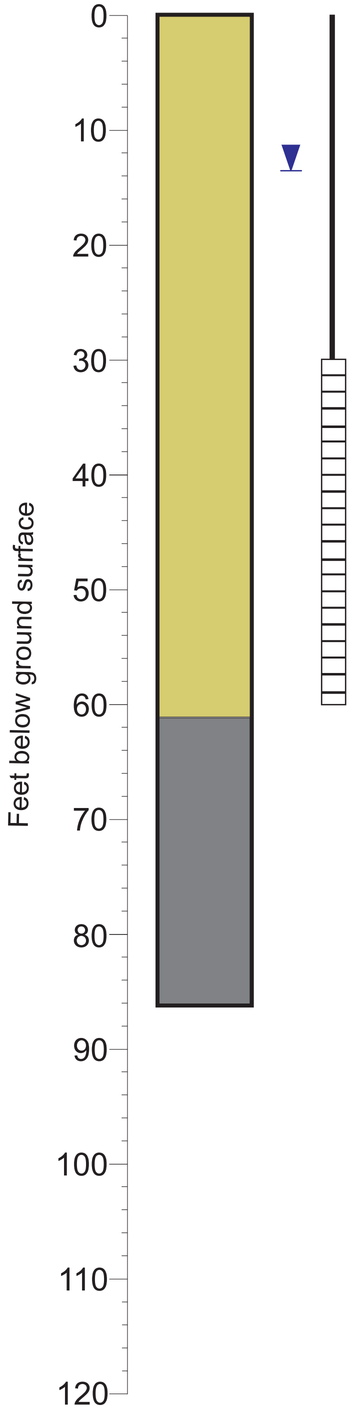
Screened interval

Hydrostratigraphic unit
- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Alton Coal Development, LLC
Coal Hollow Mine

Generalized stratigraphy



0-30 Clay, silt, sand

30-43 Clay, pea gravel, soft

43-61 Sand, clay, pea gravel

61-73 Dark gray clay (weathered Tropic Shale)

73-86 Tropic Shale

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C. PETERSEN
STATE OF UTAH

Well ID: CN0-60 (CN0-1)

Location: 1763639, 365868 ft.
Collar elevation: 6932.16 ft.
Date constructed: 15 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 30-60 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.75 ft.

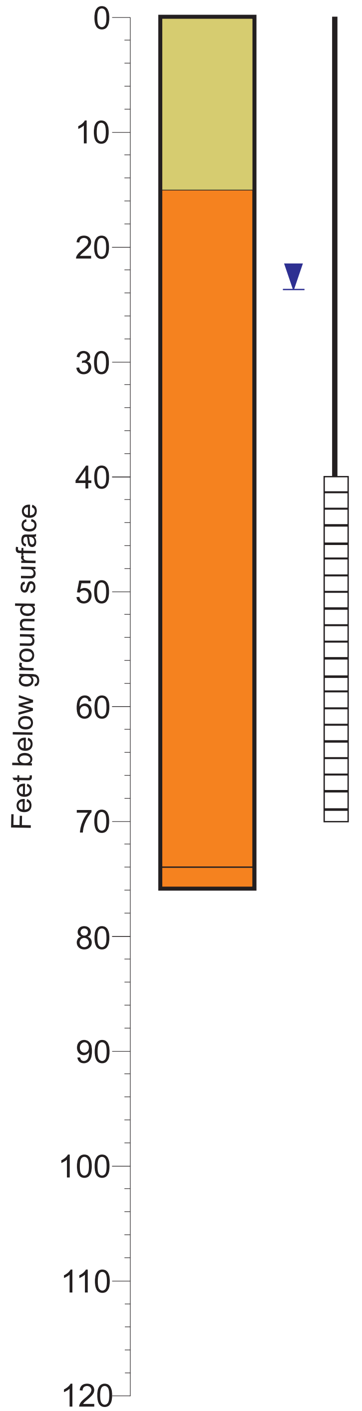
Screened interval

Hydrostratigraphic unit

- Clay/silt/sand
- Gravel (mixed matrix)
- Tropic Shale
- Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Alton Coal Development, LLC
Coal Hollow Mine



Generalized stratigraphy

0-3 Soil, clayey
3-8 Clay
8-15 Clay, gravel
15-74 Gravel, boulders
75-76 Dakota Formation ?

LICENSED PROFESSIONAL GEOLOGIST
5373615-2250
ERIK C.
PETERSEN
STATE OF UTAH

Well ID: CN7-70 (CN7-1)

Location: 1764373, 361791 ft.
Collar elevation: 6848.91 ft.
Date constructed: 16 March 2016
Drilled by: Grimshaw Drilling
Logged by: Erik Petersen, P.G.

Drilling method: Mud rotary
Well screened interval: 40-70 ft.
Well casing diameter: 2-inch
Borehole diameter: 6.25-inch
Casing stick-up: 1.42 ft.

Screened interval

Hydrostratigraphic unit

Clay/silt/sand
Gravel (mixed matrix)
Tropic Shale
Water level (March 2016)

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Coal Hollow Project

Alton Coal Development, LLC
Coal Hollow Mine

Attachment B

Aquifer pump test information for 2016 Test

In the North Private Lease area

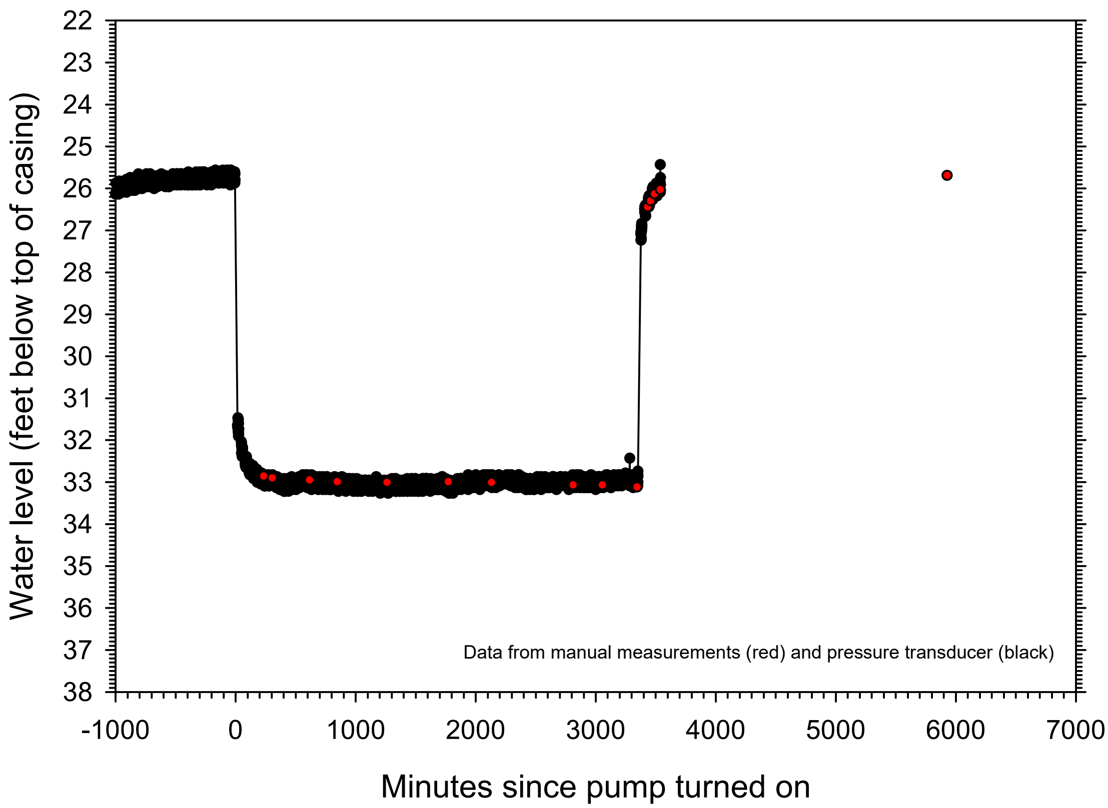
- Drawdown plots
- Pump test data

(Listed in order of increasing distance from pumping well CN3-81)

Groundwater wells monitored for 2016 pump test.

Well ID	Distance from pumped well (feet)
CN3-81	0.00
CN3-80	54.22
CN3-93	154.73
CN3-69	165.00
CN3-98	209.98
Y-103	426.91
CN4-49	508.16
Y-70	557.19
NLP-4	588.59
NLP-10	684.40
NLP-3	730.26
NLP-2	986.97
CN1-58	1150.98
CN2-70	1270.40
NLP-1	1297.25
CN5-58	1345.37
CN5-52	1380.57
CN1-43	1460.31
NLP-5	1674.23
CN0-25	1774.34
CN0-60	1849.52
NLP-12	2055.98
CN7-70	2307.79

CN3-81 - pumping well (water level)



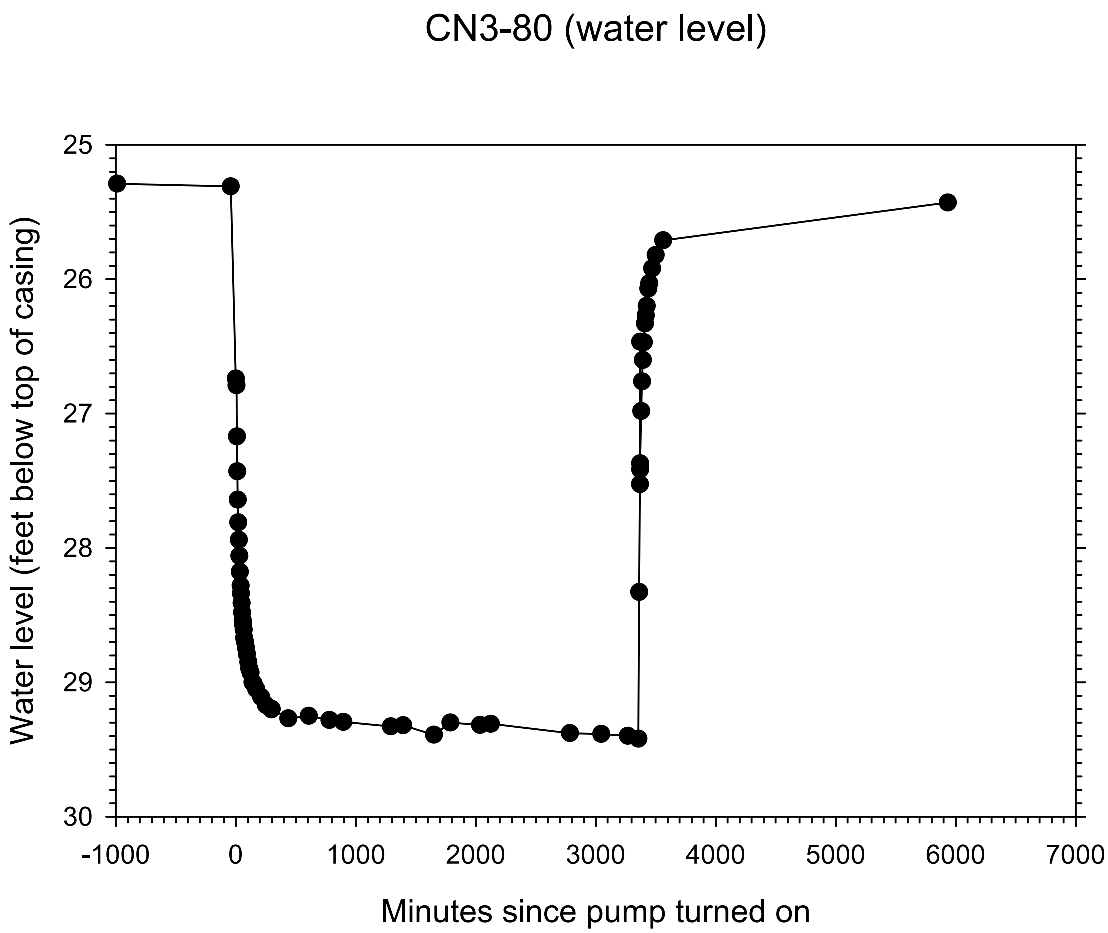
Black dots

Monitoring Well: **CN3-81 (pumping well)**

Elevation TOC	6910.8	Feet
Static level:	25.54	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	0.00	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:45	-2265.0	25.58	0.04	6885.22
4/28/2016 12:31	-1319.0	25.54	0	6885.26
4/29/2016 14:23	233.0	32.86	7.32	6877.94
4/29/2016 15:35	305.0	32.9	7.36	6877.9
4/29/2016 20:45	615.0	32.95	7.41	6877.85
4/30/2016 0:36	846.0	32.99	7.45	6877.81
4/30/2016 7:30	1260.0	33.01	7.47	6877.79
4/30/2016 16:00	1770.0	32.99	7.45	6877.81
4/30/2016 22:00	2130.0	33.01	7.47	6877.79
5/1/2016 9:20	2810.0	33.07	7.53	6877.73
5/1/2016 13:25	3055.0	33.07	7.53	6877.73
5/1/2016 18:15	3345.0	33.12	7.58	6877.68
5/1/2016 19:43	3433.0	26.44	0.9	6884.36
5/1/2016 20:08	3458.0	26.295	0.755	6884.505
5/1/2016 20:40	3490.0	26.13	0.59	6884.67
5/1/2016 21:28	3538.0	26.03	0.49	6884.77
5/3/2016 13:17	5927.0	25.69	0.15	6885.11

Note: Additional data available from pressure transducer/datalogger


CN3-80 (water level)
Water level (feet below top of casing)
25
26
27
28
29
30
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

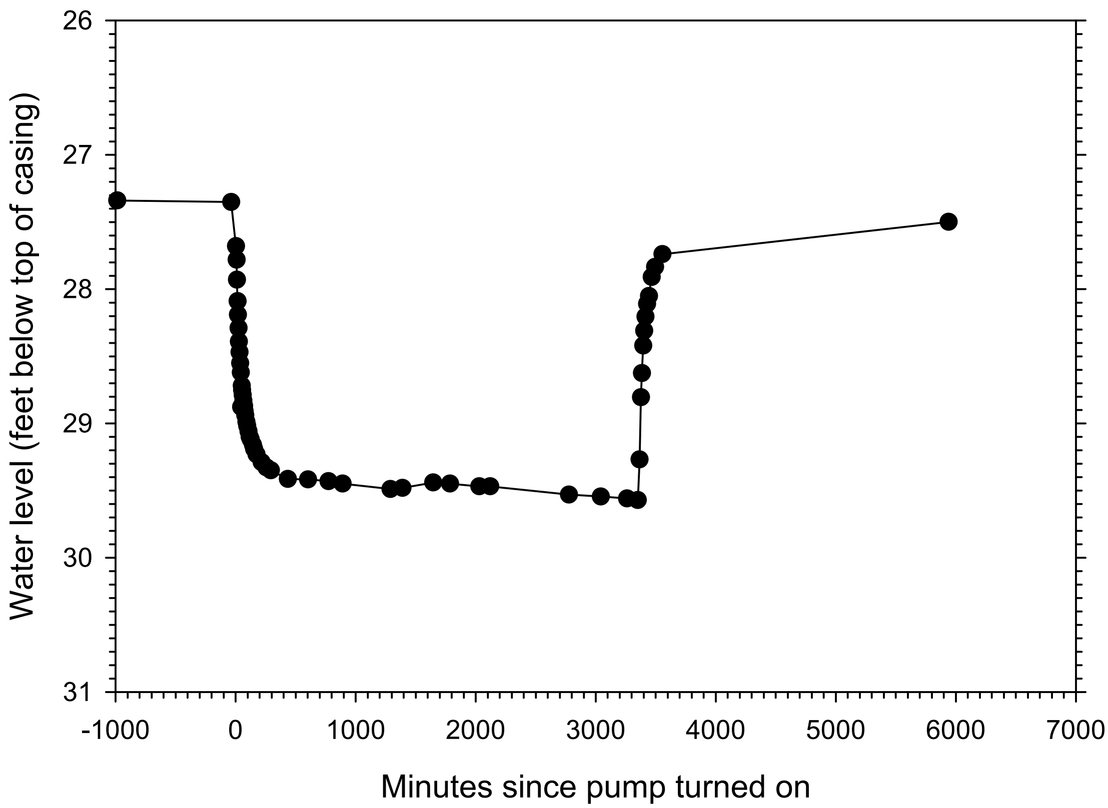
Monitoring Well: **CN3-80**

Elevation TOC	6910.29	Feet
Static level:	25.31	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	54.22	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:57	-2253.0	25.36	0.05	6884.93
4/28/2016 18:00	-990.0	25.29	-0.02	6885.00
4/29/2016 9:47	-43.0	25.31	0.00	6884.98
4/29/2016 10:30	0.0	26.74	1.43	6883.55
4/29/2016 10:35	5.0	26.79	1.48	6883.50
4/29/2016 10:38	8.0	27.17	1.86	6883.12
4/29/2016 10:42	12.0	27.43	2.12	6882.86
4/29/2016 10:46	16.0	27.64	2.33	6882.65
4/29/2016 10:50	20.0	27.81	2.50	6882.48
4/29/2016 10:54	24.0	27.94	2.63	6882.35
4/29/2016 10:59	29.0	28.06	2.75	6882.23
4/29/2016 11:03	33.0	28.18	2.87	6882.11
4/29/2016 11:09	39.0	28.28	2.97	6882.01
4/29/2016 11:13	43.0	28.34	3.03	6881.95
4/29/2016 11:18	48.0	28.41	3.10	6881.88
4/29/2016 11:22	52.0	28.48	3.17	6881.81
4/29/2016 11:26	56.0	28.54	3.23	6881.75
4/29/2016 11:30	60.0	28.57	3.26	6881.72
4/29/2016 11:35	65.0	28.61	3.30	6881.68
4/29/2016 11:40	70.0	28.67	3.36	6881.62
4/29/2016 11:46	76.0	28.70	3.39	6881.59
4/29/2016 11:53	83.0	28.74	3.43	6881.55
4/29/2016 12:02	92.0	28.79	3.48	6881.50
4/29/2016 12:13	103.0	28.85	3.54	6881.44
4/29/2016 12:22	112.0	28.90	3.59	6881.39
4/29/2016 12:32	122.0	28.93	3.62	6881.36
4/29/2016 12:49	139.0	29.00	3.69	6881.29
4/29/2016 12:58	148.0	29.01	3.70	6881.28
4/29/2016 13:19	169.0	29.05	3.74	6881.24
4/29/2016 14:01	211.0	29.11	3.80	6881.18
4/29/2016 14:41	251.0	29.17	3.86	6881.12
4/29/2016 15:27	297.0	29.20	3.89	6881.09
4/29/2016 15:29	299.0	29.20	3.89	6881.09
4/29/2016 17:48	438.0	29.27	3.96	6881.02
4/29/2016 20:37	607.0	29.25	3.94	6881.04
4/29/2016 23:30	780.0	29.28	3.97	6881.01

4/30/2016 1:26	896.0	29.30	3.99	6881.00
4/30/2016 8:02	1292.0	29.33	4.02	6880.96
4/30/2016 9:45	1395.0	29.32	4.01	6880.97
4/30/2016 14:00	1650.0	29.39	4.08	6880.90
4/30/2016 16:18	1788.0	29.30	3.99	6880.99
4/30/2016 20:24	2034.0	29.32	4.01	6880.97
4/30/2016 21:55	2125.0	29.31	4.00	6880.98
5/1/2016 8:53	2783.0	29.38	4.07	6880.91
5/1/2016 13:17	3047.0	29.39	4.08	6880.91
5/1/2016 16:58	3268.0	29.40	4.09	6880.89
5/1/2016 18:26	3356.0	29.42	4.11	6880.87
5/1/2016 18:32	3362.5	28.33	3.02	6881.96
5/1/2016 18:39	3369.0	27.53	2.22	6882.77
5/1/2016 18:39	3369.7	26.47	1.16	6883.83
5/1/2016 18:40	3370.5	27.42	2.11	6882.88
5/1/2016 18:41	3371.0	27.37	2.06	6882.92
5/1/2016 18:49	3379.5	26.98	1.67	6883.31
5/1/2016 18:57	3387.0	26.76	1.45	6883.53
5/1/2016 19:03	3393.0	26.60	1.29	6883.69
5/1/2016 19:11	3401.0	26.47	1.16	6883.82
5/1/2016 19:21	3411.0	26.33	1.02	6883.96
5/1/2016 19:26	3416.8	26.27	0.96	6884.02
5/1/2016 19:34	3424.0	26.20	0.89	6884.09
5/1/2016 19:49	3439.0	26.07	0.76	6884.22
5/1/2016 19:58	3448.0	26.03	0.72	6884.26
5/1/2016 20:21	3471.0	25.92	0.61	6884.37
5/1/2016 20:50	3500.0	25.82	0.51	6884.47
5/1/2016 21:52	3562.0	25.71	0.40	6884.58
5/3/2016 13:25	5935.0	25.43	0.12	6884.86

CN3-93 (water level)

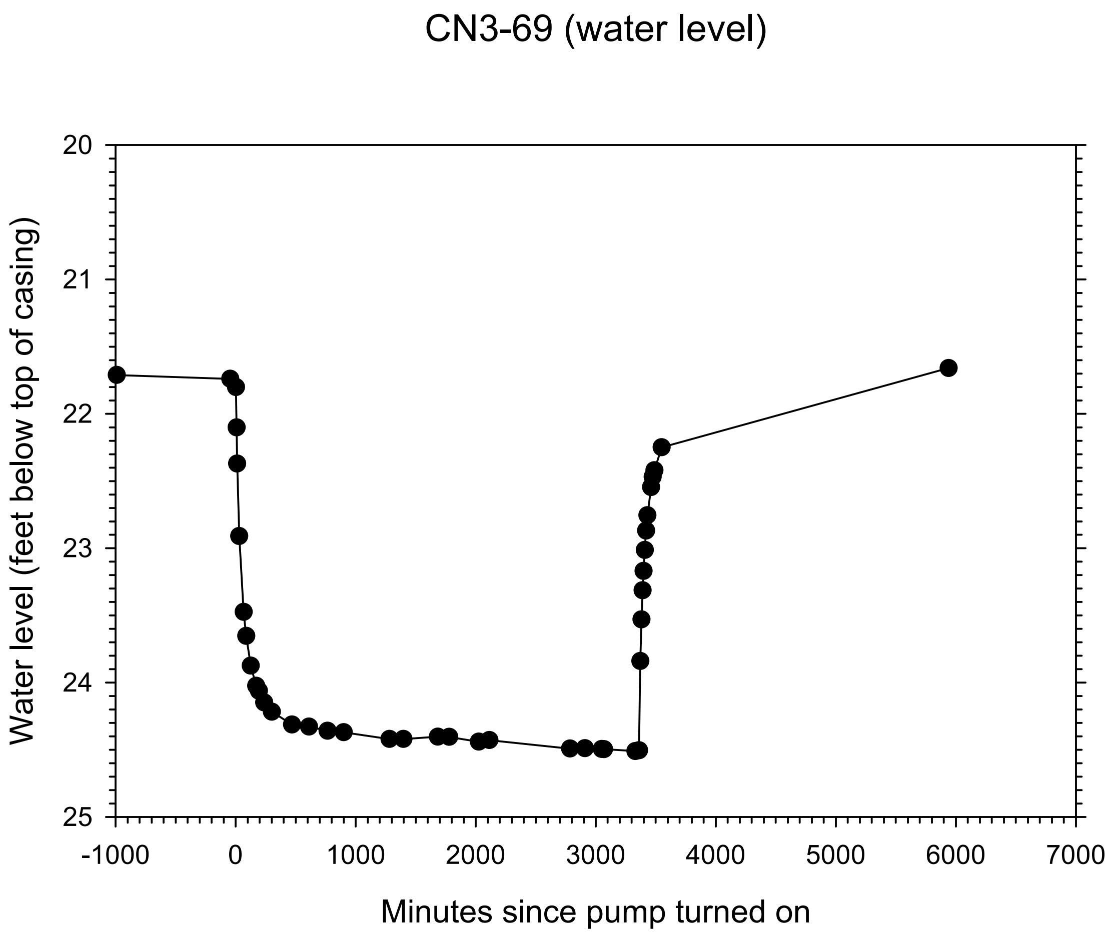


Monitoring Well: **CN3-93**

Elevation TOC	6912.34	Feet
Static level:	27.35	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	154.73	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:55	-2255.0	27.39	0.04	6884.95
4/28/2016 18:04	-986.0	27.34	-0.01	6885
4/29/2016 9:53	-37.0	27.35	0	6884.99
4/29/2016 10:33	3.0	27.68	0.33	6884.66
4/29/2016 10:37	7.0	27.78	0.43	6884.56
4/29/2016 10:41	11.0	27.93	0.58	6884.41
4/29/2016 10:45	15.0	28.09	0.74	6884.25
4/29/2016 10:49	19.0	28.19	0.84	6884.15
4/29/2016 10:53	23.0	28.29	0.94	6884.05
4/29/2016 10:57	27.0	28.39	1.04	6883.95
4/29/2016 11:02	32.0	28.47	1.12	6883.87
4/29/2016 11:07	37.0	28.55	1.2	6883.79
4/29/2016 11:12	42.0	28.62	1.27	6883.72
4/29/2016 11:16	46.0	28.88	1.53	6883.46
4/29/2016 11:20	50.0	28.72	1.37	6883.62
4/29/2016 11:24	54.0	28.75	1.4	6883.59
4/29/2016 11:29	59.0	28.79	1.44	6883.55
4/29/2016 11:33	63.0	28.83	1.48	6883.51
4/29/2016 11:39	69.0	28.87	1.52	6883.47
4/29/2016 11:39	69.0	28.87	1.52	6883.47
4/29/2016 11:44	74.0	28.91	1.56	6883.43
4/29/2016 11:50	80.0	28.94	1.59	6883.4
4/29/2016 11:58	88.0	28.99	1.64	6883.35
4/29/2016 12:06	96.0	29.02	1.67	6883.32
4/29/2016 12:17	107.0	29.06	1.71	6883.28
4/29/2016 12:26	116.0	29.1	1.75	6883.24
4/29/2016 12:36	126.0	29.12	1.77	6883.22
4/29/2016 12:53	143.0	29.16	1.81	6883.18
4/29/2016 13:02	152.0	29.19	1.84	6883.15
4/29/2016 13:24	174.0	29.23	1.88	6883.11
4/29/2016 14:05	215.0	29.29	1.94	6883.05
4/29/2016 14:45	255.0	29.33	1.98	6883.01
4/29/2016 15:23	293.0	29.35	2	6882.99
4/29/2016 17:45	435.0	29.415	2.065	6882.925
4/29/2016 20:32	602.0	29.418	2.068	6882.922
4/29/2016 23:23	773.0	29.43	2.08	6882.91

4/30/2016 1:20	890.0	29.45	2.1	6882.89
4/30/2016 7:59	1289.0	29.49	2.14	6882.85
4/30/2016 9:40	1390.0	29.48	2.13	6882.86
4/30/2016 13:55	1645.0	29.44	2.09	6882.9
4/30/2016 16:14	1784.0	29.45	2.1	6882.89
4/30/2016 20:20	2030.0	29.47	2.12	6882.87
4/30/2016 21:49	2119.0	29.47	2.12	6882.87
5/1/2016 8:46	2776.0	29.53	2.18	6882.81
5/1/2016 13:12	3042.0	29.545	2.195	6882.795
5/1/2016 16:52	3262.0	29.56	2.21	6882.78
5/1/2016 18:22	3352.0	29.572	2.222	6882.768
5/1/2016 18:35	3365.0	29.27	1.92	6883.07
5/1/2016 18:47	3377.0	28.805	1.455	6883.535
5/1/2016 18:54	3384.5	28.625	1.275	6883.715
5/1/2016 19:06	3396.5	28.42	1.07	6883.92
5/1/2016 19:14	3404.0	28.31	0.96	6884.03
5/1/2016 19:24	3414.7	28.205	0.855	6884.135
5/1/2016 19:38	3428.0	28.11	0.76	6884.23
5/1/2016 19:54	3444.0	28.05	0.7	6884.29
5/1/2016 20:16	3466.0	27.91	0.56	6884.43
5/1/2016 20:45	3495.0	27.835	0.485	6884.505
5/1/2016 21:46	3556.0	27.74	0.39	6884.6
5/3/2016 13:30	5940.0	27.5	0.15	6884.84


CN3-69 (water level)
Water level (feet below top of casing)
Minutes since pump turned on
20
21
22
23
24
25
-1000
0
1000
2000
3000
4000
5000
6000
7000

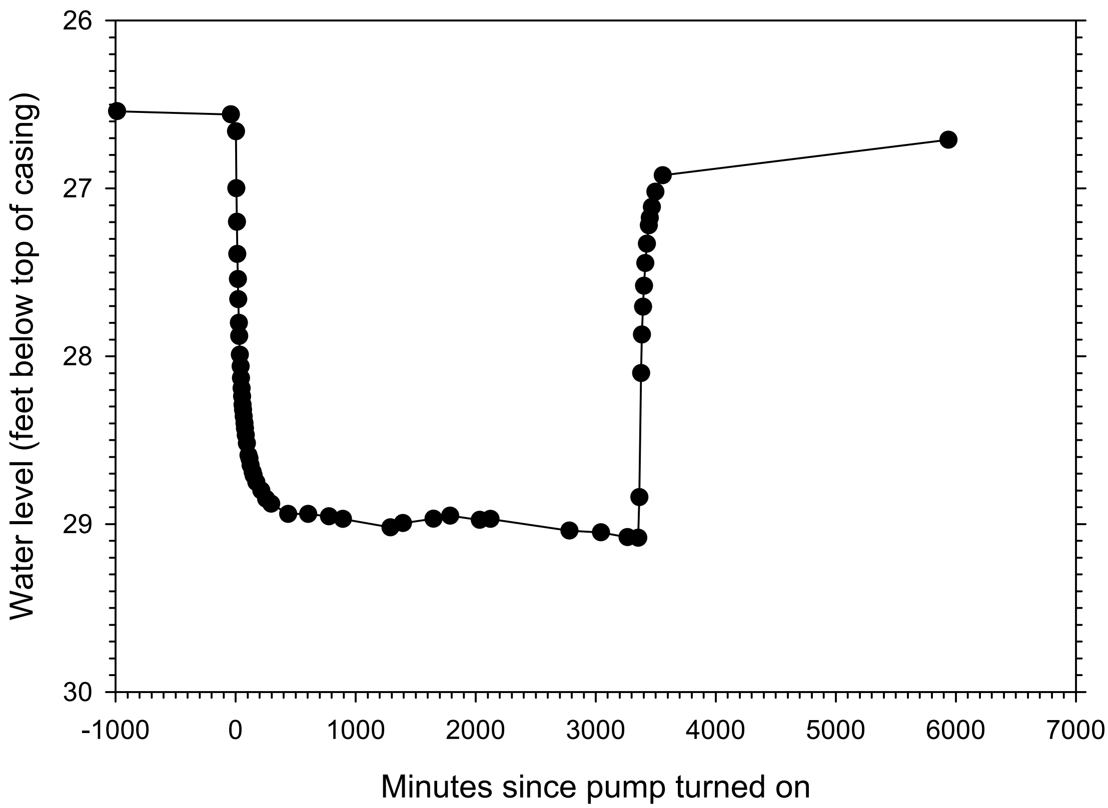
Monitoring Well: **CN3-69**

Elevation TOC	6907.54	Feet
Static level:	21.74	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	165.00	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:25	-2225.0	21.74	0	6885.8
4/28/2016 12:38	-1312.0	21.72	-0.02	6885.82
4/28/2016 17:58	-992.0	21.71	-0.03	6885.83
4/29/2016 9:45	-45.0	21.74	0	6885.8
4/29/2016 10:32	2.2	21.8	0.06	6885.74
4/29/2016 10:37	7.0	22.1	0.36	6885.44
4/29/2016 10:42	12.5	22.37	0.63	6885.17
4/29/2016 10:59	29.7	22.91	1.17	6884.63
4/29/2016 11:36	66.5	23.475	1.735	6884.065
4/29/2016 11:57	87.5	23.653	1.913	6883.887
4/29/2016 12:36	126.0	23.875	2.135	6883.665
4/29/2016 13:21	171.0	24.025	2.285	6883.515
4/29/2016 13:43	193.0	24.062	2.322	6883.478
4/29/2016 14:27	237.0	24.15	2.41	6883.39
4/29/2016 15:32	302.0	24.218	2.478	6883.322
4/29/2016 18:20	470.0	24.313	2.573	6883.227
4/29/2016 20:41	611.0	24.33	2.59	6883.21
4/29/2016 23:15	765.0	24.36	2.62	6883.18
4/30/2016 1:30	900.0	24.37	2.63	6883.17
4/30/2016 7:51	1281.0	24.42	2.68	6883.12
4/30/2016 9:48	1398.0	24.42	2.68	6883.12
4/30/2016 14:34	1684.0	24.403	2.663	6883.137
4/30/2016 16:08	1778.0	24.405	2.665	6883.135
4/30/2016 20:15	2025.0	24.44	2.7	6883.1
4/30/2016 21:43	2113.0	24.43	2.69	6883.11
5/1/2016 8:55	2785.0	24.492	2.752	6883.048
5/1/2016 11:00	2910.0	24.49	2.75	6883.05
5/1/2016 13:21	3051.0	24.495	2.755	6883.045
5/1/2016 13:40	3070.0	24.496	2.756	6883.044
5/1/2016 18:01	3331.0	24.51	2.77	6883.03
5/1/2016 18:31	3361.0	24.505	2.765	6883.035
5/1/2016 18:42	3372.5	23.84	2.1	6883.7
5/1/2016 18:52	3382.0	23.53	1.79	6884.01
5/1/2016 19:00	3390.5	23.315	1.575	6884.225
5/1/2016 19:08	3398.5	23.17	1.43	6884.37
5/1/2016 19:18	3408.5	23.015	1.275	6884.525

5/1/2016 19:29	3419.5	22.87	1.13	6884.67
5/1/2016 19:40	3430.5	22.755	1.015	6884.785
5/1/2016 20:11	3461.0	22.545	0.805	6884.995
5/1/2016 20:24	3474.0	22.47	0.73	6885.07
5/1/2016 20:39	3489.0	22.42	0.68	6885.12
5/1/2016 21:39	3549.0	22.25	0.51	6885.29
5/3/2016 13:30	5940.0	21.66	-0.08	6885.88

CN3-98 (water level)

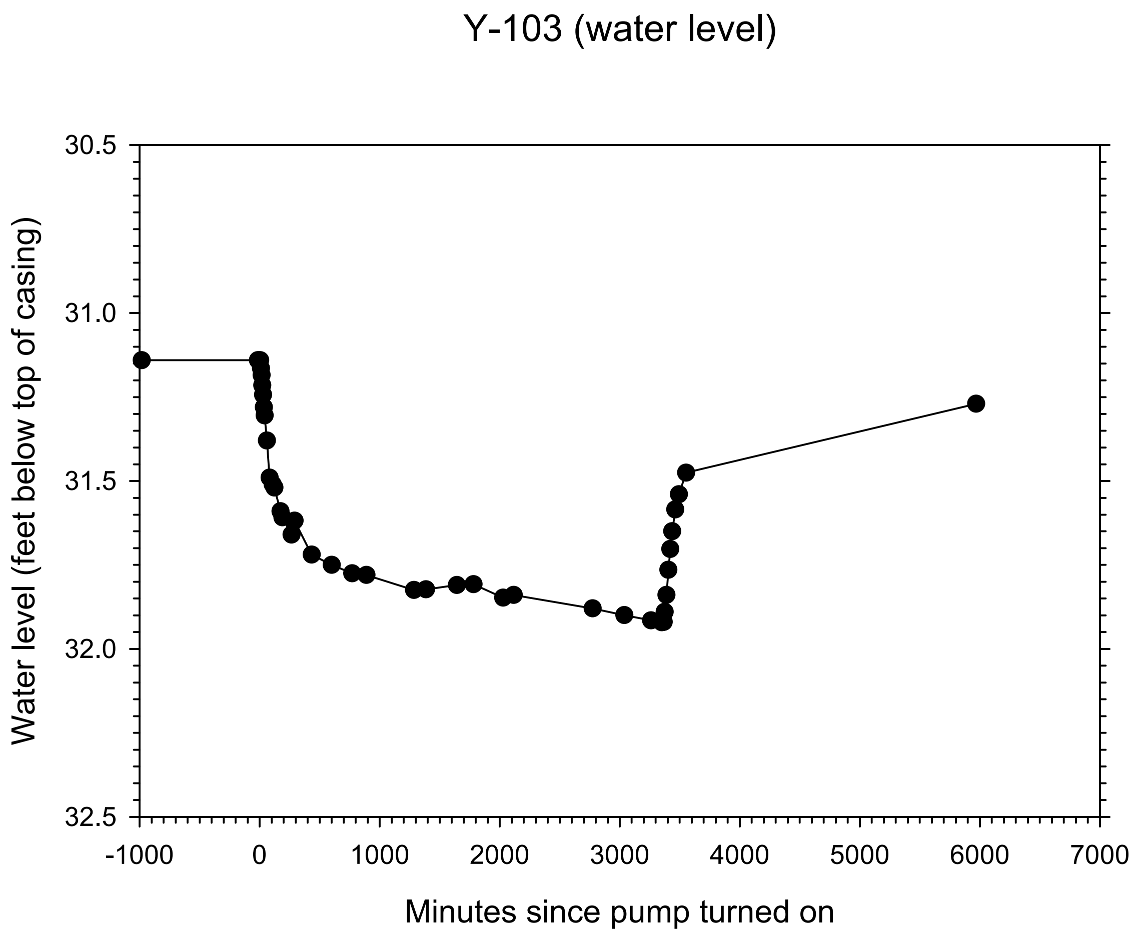


Monitoring Well: **CN3-98**

Elevation TOC	6911.07	Feet
Static level:	26.56	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	209.98	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:59	-2251.0	26.6	0.04	6884.47
4/28/2016 13:34	-1256.0	26.56	0	6884.51
4/28/2016 18:02	-988.0	26.54	-0.02	6884.53
4/29/2016 9:50	-40.0	26.56	0	6884.51
4/29/2016 10:32	2.0	26.66	0.1	6884.41
4/29/2016 10:36	6.0	27	0.44	6884.07
4/29/2016 10:40	10.0	27.2	0.64	6883.87
4/29/2016 10:44	14.0	27.39	0.83	6883.68
4/29/2016 10:48	18.0	27.54	0.98	6883.53
4/29/2016 10:52	22.0	27.66	1.1	6883.41
4/29/2016 10:56	26.0	27.8	1.24	6883.27
4/29/2016 11:00	30.0	27.88	1.32	6883.19
4/29/2016 11:05	35.0	27.99	1.43	6883.08
4/29/2016 11:10	40.0	28.06	1.5	6883.01
4/29/2016 11:14	44.0	28.13	1.57	6882.94
4/29/2016 11:19	49.0	28.19	1.63	6882.88
4/29/2016 11:23	53.0	28.24	1.68	6882.83
4/29/2016 11:27	57.0	28.29	1.73	6882.78
4/29/2016 11:32	62.0	28.32	1.76	6882.75
4/29/2016 11:37	67.0	28.36	1.8	6882.71
4/29/2016 11:42	72.0	28.4	1.84	6882.67
4/29/2016 11:48	78.0	28.43	1.87	6882.64
4/29/2016 11:54	84.0	28.47	1.91	6882.6
4/29/2016 12:04	94.0	28.52	1.96	6882.55
4/29/2016 12:16	106.0	28.59	2.03	6882.48
4/29/2016 12:24	114.0	28.61	2.05	6882.46
4/29/2016 12:34	124.0	28.65	2.09	6882.42
4/29/2016 12:51	141.0	28.69	2.13	6882.38
4/29/2016 13:00	150.0	28.71	2.15	6882.36
4/29/2016 13:22	172.0	28.75	2.19	6882.32
4/29/2016 14:03	213.0	28.8	2.24	6882.27
4/29/2016 14:43	253.0	28.85	2.29	6882.22
4/29/2016 15:25	295.0	28.88	2.32	6882.19
4/29/2016 17:45	435.0	29.415	2.855	6881.655
4/29/2016 17:47	437.0	28.94	2.38	6882.13
4/29/2016 20:34	604.0	28.94	2.38	6882.13

4/29/2016 23:26	776.0	28.955	2.395	6882.115
4/30/2016 1:23	893.0	28.97	2.41	6882.1
4/30/2016 7:59	1289.0	29.02	2.46	6882.05
4/30/2016 9:42	1392.0	28.995	2.435	6882.075
4/30/2016 13:57	1647.0	28.968	2.408	6882.102
4/30/2016 16:16	1786.0	28.95	2.39	6882.12
4/30/2016 20:22	2032.0	28.975	2.415	6882.095
4/30/2016 21:52	2122.0	28.97	2.41	6882.1
5/1/2016 8:50	2780.0	29.04	2.48	6882.03
5/1/2016 13:14	3044.0	29.05	2.49	6882.02
5/1/2016 16:55	3265.0	29.078	2.518	6881.992
5/1/2016 18:24	3354.0	29.082	2.522	6881.988
5/1/2016 18:33	3363.8	28.84	2.28	6882.23
5/1/2016 18:48	3378.0	28.1	1.54	6882.97
5/1/2016 18:55	3385.5	27.87	1.31	6883.2
5/1/2016 19:04	3394.5	27.705	1.145	6883.365
5/1/2016 19:12	3402.3	27.58	1.02	6883.49
5/1/2016 19:23	3413.0	27.445	0.885	6883.625
5/1/2016 19:36	3426.0	27.33	0.77	6883.74
5/1/2016 19:52	3442.0	27.22	0.66	6883.85
5/1/2016 20:00	3450.0	27.175	0.615	6883.895
5/1/2016 20:18	3468.0	27.11	0.55	6883.96
5/1/2016 20:47	3497.0	27.02	0.46	6884.05
5/1/2016 21:49	3559.0	26.922	0.362	6884.148
5/3/2016 13:28	5938.0	26.71	0.15	6884.36

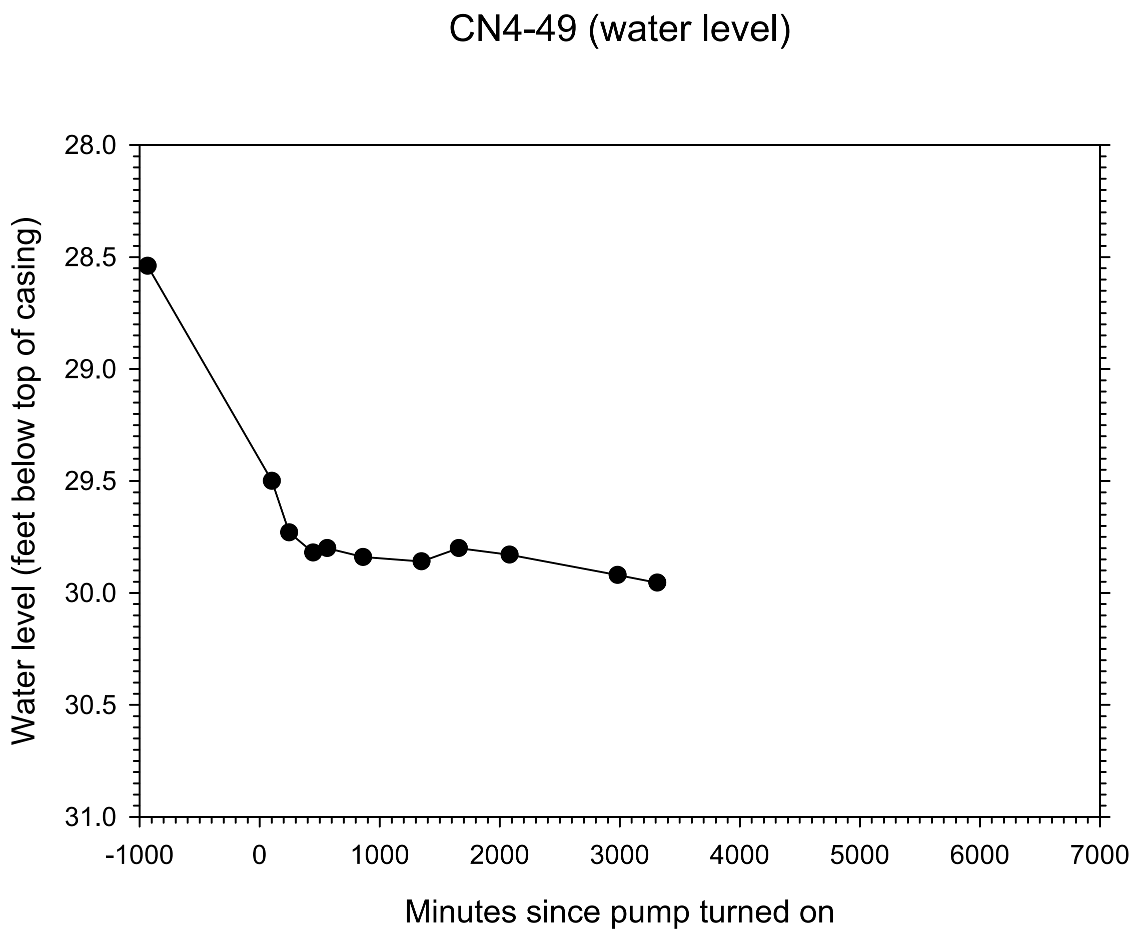

Y-103 (water level)
Water level (feet below top of casing)
30.5
31.0
31.5
32.0
32.5
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **Y-103**

Elevation TOC	6921.75	Feet
Static level:	31.14	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	426.91	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:50	-2260.0	31.15	0.01	6890.6
4/28/2016 18:07	-983.0	31.14	0	6890.61
4/29/2016 10:14	-16.0	31.14	0	6890.61
4/29/2016 10:34	4.7	31.14	0	6890.61
4/29/2016 10:40	10.5	31.165	0.025	6890.585
4/29/2016 10:44	14.8	31.185	0.045	6890.565
4/29/2016 10:51	21.0	31.215	0.075	6890.535
4/29/2016 10:58	28.5	31.243	0.103	6890.507
4/29/2016 11:04	34.8	31.28	0.14	6890.47
4/29/2016 11:11	41.5	31.305	0.165	6890.445
4/29/2016 11:30	60.0	31.38	0.24	6890.37
4/29/2016 11:52	82.0	31.49	0.35	6890.26
4/29/2016 12:18	108.0	31.51	0.37	6890.24
4/29/2016 12:33	123.0	31.52	0.38	6890.23
4/29/2016 13:24	174.0	31.59	0.45	6890.16
4/29/2016 13:40	190.0	31.608	0.468	6890.142
4/29/2016 14:54	264.0	31.66	0.52	6890.09
4/29/2016 15:21	291.0	31.618	0.478	6890.132
4/29/2016 17:43	433.0	31.72	0.58	6890.03
4/29/2016 20:30	600.0	31.75	0.61	6890.00
4/29/2016 23:20	770.0	31.775	0.635	6889.975
4/30/2016 1:18	888.0	31.78	0.64	6889.97
4/30/2016 7:55	1285.0	31.825	0.685	6889.925
4/30/2016 9:35	1385.0	31.823	0.683	6889.927
4/30/2016 13:53	1643.0	31.81	0.67	6889.94
4/30/2016 16:12	1782.0	31.808	0.668	6889.942
4/30/2016 20:18	2028.0	31.848	0.708	6889.902
4/30/2016 21:46	2116.0	31.84	0.7	6889.91
5/1/2016 8:44	2774.0	31.88	0.74	6889.87
5/1/2016 13:10	3040.0	31.9	0.76	6889.85
5/1/2016 16:51	3261.0	31.915	0.775	6889.835
5/1/2016 18:21	3351.0	31.921	0.781	6889.829
5/1/2016 18:37	3367.0	31.92	0.78	6889.83
5/1/2016 18:45	3375.5	31.89	0.75	6889.86
5/1/2016 18:59	3389.0	31.84	0.7	6889.91
5/1/2016 19:16	3406.0	31.765	0.625	6889.985

5/1/2016 19:32	3422.0	31.703	0.563	6890.047
5/1/2016 19:47	3437.0	31.65	0.51	6890.1
5/1/2016 20:14	3464.0	31.585	0.445	6890.165
5/1/2016 20:43	3493.0	31.54	0.4	6890.21
5/1/2016 21:43	3553.0	31.475	0.335	6890.275
5/3/2016 13:59	5969.0	31.27	0.13	6890.48

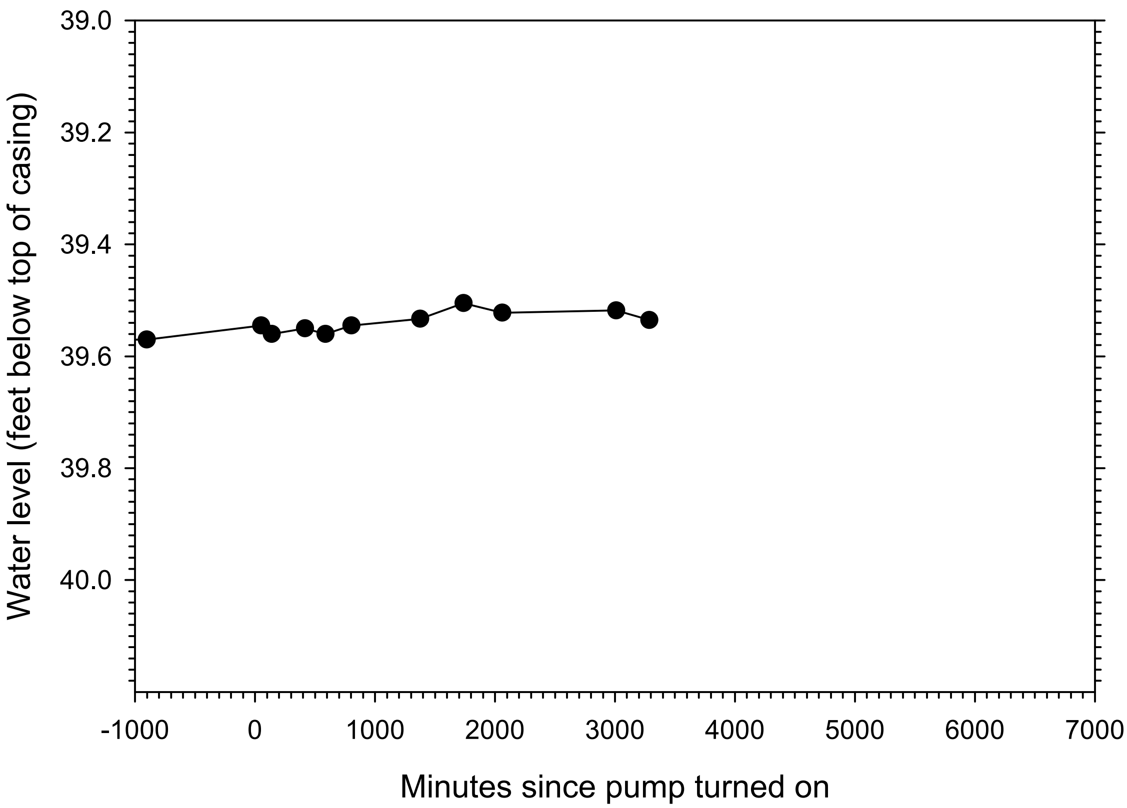

CN4-49 (water level)
Water level (feet below top of casing)
28.0
28.5
29.0
29.5
30.0
30.5
31.0
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN4-49**

Elevation TOC	6912.09	Feet
Static level:	28.55	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	508.16	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:40	-2210.0	28.59	0.04	6883.5
4/28/2016 18:57	-933.0	28.54	-0.01	6883.55
4/29/2016 12:11	101.0	29.5	0.95	6882.59
4/29/2016 14:36	246.0	29.73	1.18	6882.36
4/29/2016 17:56	446.0	29.82	1.27	6882.27
4/29/2016 19:53	563.0	29.8	1.25	6882.29
4/30/2016 0:51	861.0	29.84	1.29	6882.25
4/30/2016 8:58	1348.0	29.86	1.31	6882.23
4/30/2016 14:09	1659.0	29.8	1.25	6882.29
4/30/2016 21:10	2080.0	29.83	1.28	6882.26
5/1/2016 12:12	2982.0	29.92	1.37	6882.17
5/1/2016 17:42	3312.0	29.955	1.41	6882.135

Y-70 (water level)

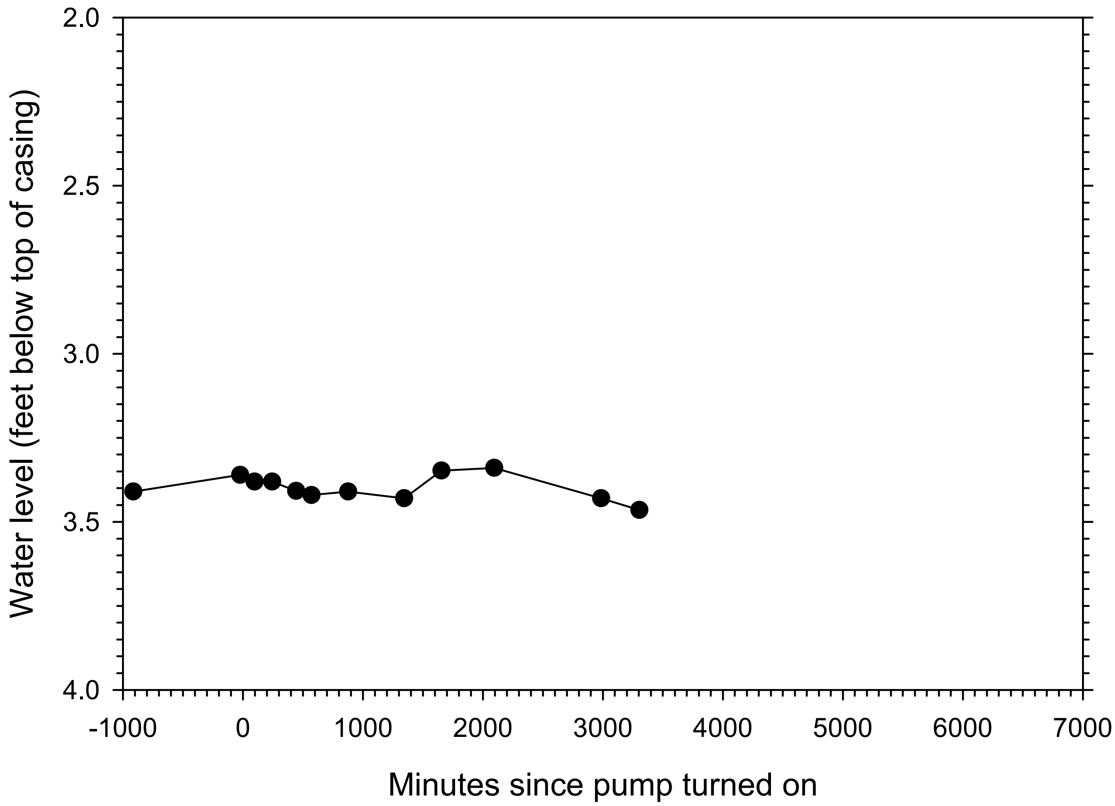


Monitoring Well: **Y-70**

Elevation TOC	6902.78	Feet
Static level:	39.57	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	557.19	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 22:15	-2175.0	39.57	0.00	6863.21
4/28/2016 19:27	-903.0	39.57	0.00	6863.21
4/29/2016 11:20	50.0	39.545	-0.025	6863.235
4/29/2016 12:49	139.0	39.56	-0.01	6863.22
4/29/2016 17:25	415.0	39.55	-0.02	6863.23
4/29/2016 20:16	586.0	39.56	-0.01	6863.22
4/29/2016 23:52	802.0	39.545	-0.025	6863.235
4/30/2016 9:25	1375.0	39.533	-0.037	6863.247
4/30/2016 15:26	1736.0	39.505	-0.065	6863.275
4/30/2016 20:50	2060.0	39.522	-0.048	6863.258
5/1/2016 12:40	3010.0	39.518	-0.052	6863.262
5/1/2016 17:18	3288.0	39.535	-0.035	6863.245

NLP-4 (water level)

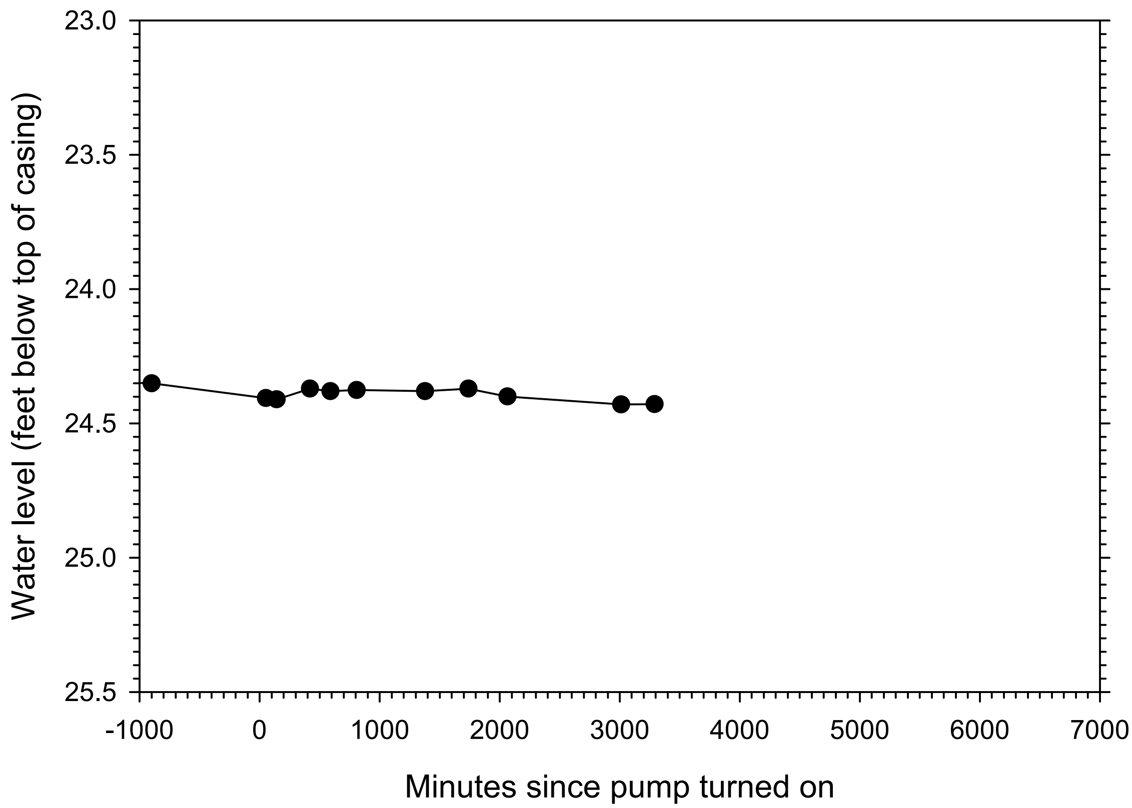


Monitoring Well: **NLP-4**

Elevation TOC	6871.86	Feet
Static level:	3.41	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	588.59	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/28/2016 19:15	-915.0	3.41	0.00	6868.45
4/29/2016 10:07	-23.0	3.36	-0.05	6868.5
4/29/2016 12:07	97.0	3.38	-0.03	6868.48
4/29/2016 14:32	242.0	3.38	-0.03	6868.48
4/29/2016 17:53	443.0	3.408	0.00	6868.452
4/29/2016 20:00	570.0	3.42	0.01	6868.44
4/30/2016 1:06	876.0	3.41	0.00	6868.45
4/30/2016 8:53	1343.0	3.43	0.02	6868.43
4/30/2016 14:04	1654.0	3.348	-0.06	6868.512
4/30/2016 21:24	2094.0	3.34	-0.07	6868.52
5/1/2016 12:17	2987.0	3.43	0.02	6868.43
5/1/2016 17:35	3305.0	3.465	0.05	6868.395

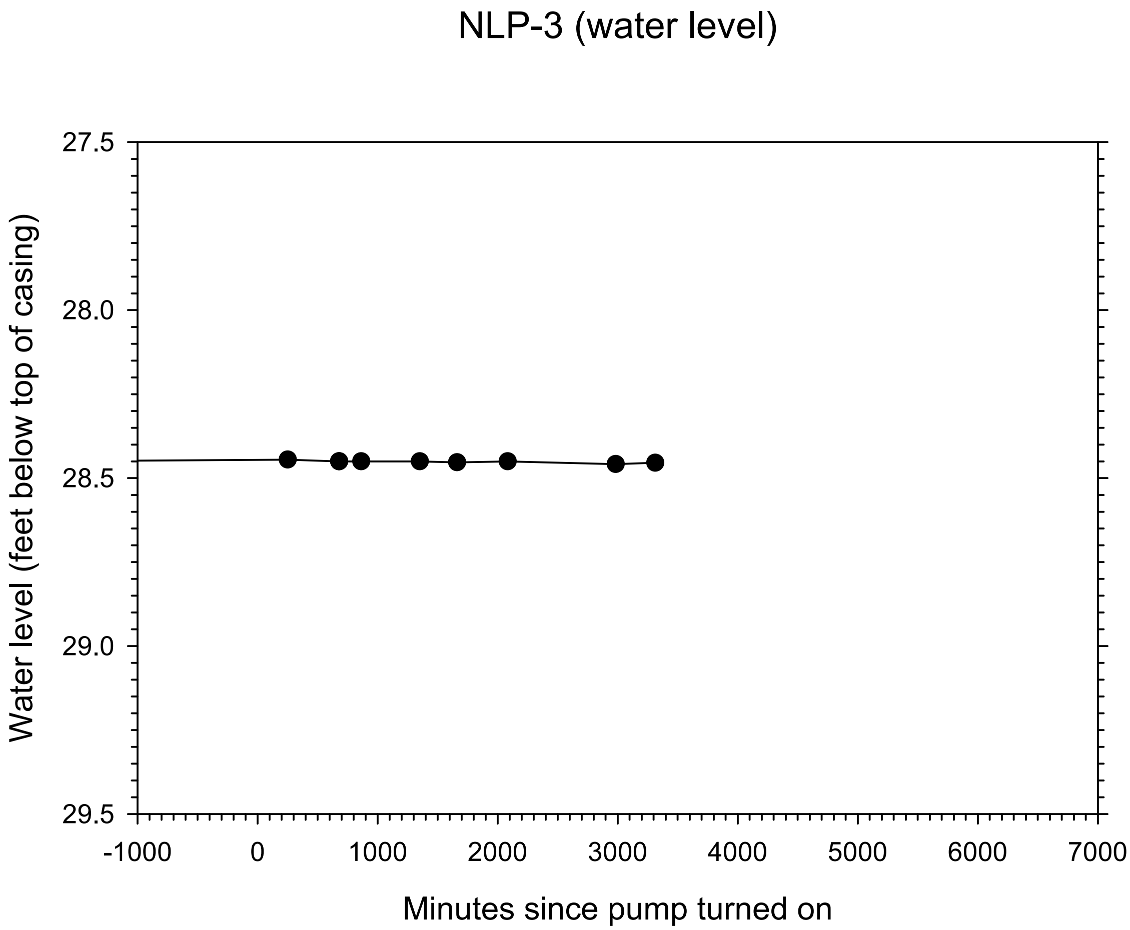
NLP-10 (water level)



Monitoring Well: **NLP-10**

Elevation TOC	6902.62	Feet
Static level:	24.35	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	684.40	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 22:20	-2170.0	24.34	-0.01	6878.28
4/28/2016 19:30	-900.0	24.35	0.00	6878.27
4/29/2016 11:22	52.1	24.405	0.05	6878.22
4/29/2016 12:51	141.0	24.41	0.06	6878.21
4/29/2016 17:28	418.0	24.37	0.02	6878.25
4/29/2016 20:19	589.0	24.38	0.03	6878.24
4/29/2016 23:57	807.0	24.375	0.02	6878.25
4/30/2016 9:27	1377.0	24.38	0.03	6878.24
4/30/2016 15:28	1738.0	24.37	0.02	6878.25
4/30/2016 20:53	2063.0	24.4	0.05	6878.22
5/1/2016 12:42	3012.0	24.43	0.08	6878.19
5/1/2016 17:21	3291.0	24.429	0.08	6878.19

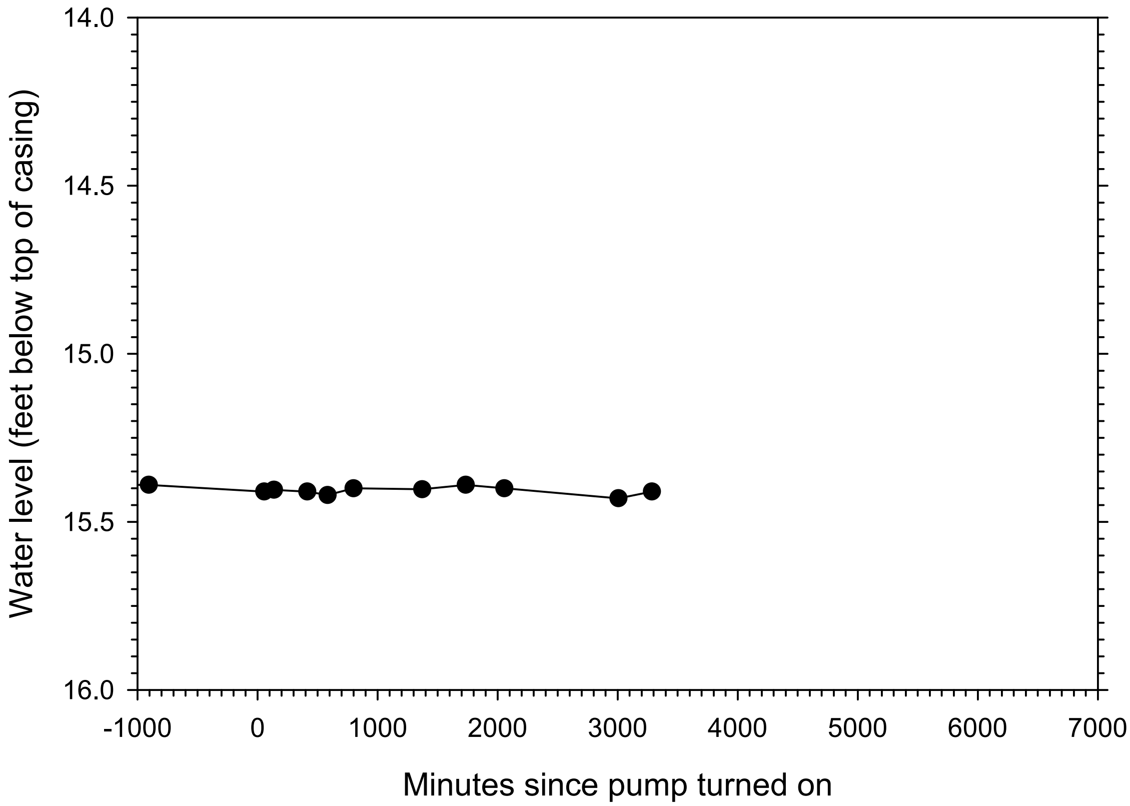

NLP-3 (water level)
Water level (feet below top of casing)
27.5
28.0
28.5
29.0
29.5
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **NLP-3**

Elevation TOC	6917.98	Feet
Static level:	28.45	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	730.26	Feet

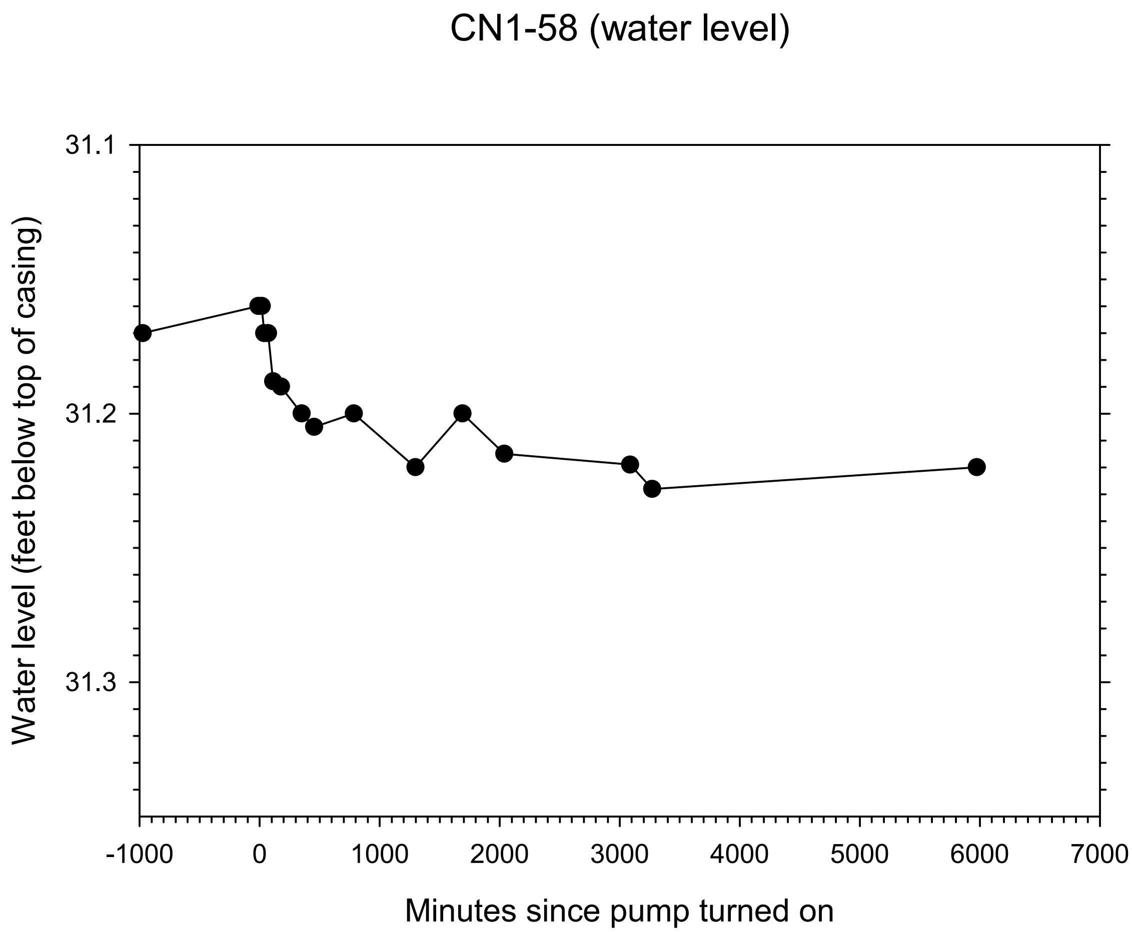
Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:55	-2195.0	28.45	0.00	6889.53
4/29/2016 14:40	250.0	28.445	0.00	6889.535
4/29/2016 21:50	680.0	28.45	0.00	6889.53
4/29/2016 21:50	680.0	28.45	0.00	6889.53
4/30/2016 0:54	864.0	28.45	0.00	6889.53
4/30/2016 9:01	1351.0	28.45	0.00	6889.53
4/30/2016 14:12	1662.0	28.453	0.00	6889.527
4/30/2016 21:12	2082.0	28.45	0.00	6889.53
5/1/2016 12:14	2984.0	28.458	0.01	6889.522
5/1/2016 17:44	3314.0	28.454	0.00	6889.526

NLP-2 (water level)



Monitoring Well:	**NLP-2**	
Elevation TOC	6910.39	Feet
Static level:	15.39	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	986.97	Feet

Date and Time	**Elapsed minutes since pump on (minutes)**	**Depth to water (feet below toc)**	**Drawdown (feet)**	**Wat el. (feet)**
4/27/2016 22:10	-2180.0	15.39	0.00	6895
4/28/2016 19:24	-906.0	15.39	0.00	6895
4/29/2016 11:25	55.2	15.41	0.02	6894.98
4/29/2016 12:46	136.5	15.405	0.01	6894.985
4/29/2016 17:23	413.0	15.41	0.02	6894.98
4/29/2016 20:13	583.0	15.42	0.03	6894.97
4/29/2016 23:49	799.0	15.4	0.01	6894.99
4/30/2016 9:21	1371.0	15.403	0.01	6894.987
4/30/2016 15:23	1733.0	15.39	0.00	6895
4/30/2016 20:46	2056.0	15.4	0.01	6894.99
5/1/2016 12:38	3008.0	15.43	0.04	6894.96
5/1/2016 17:16	3286.0	15.41	0.02	6894.98



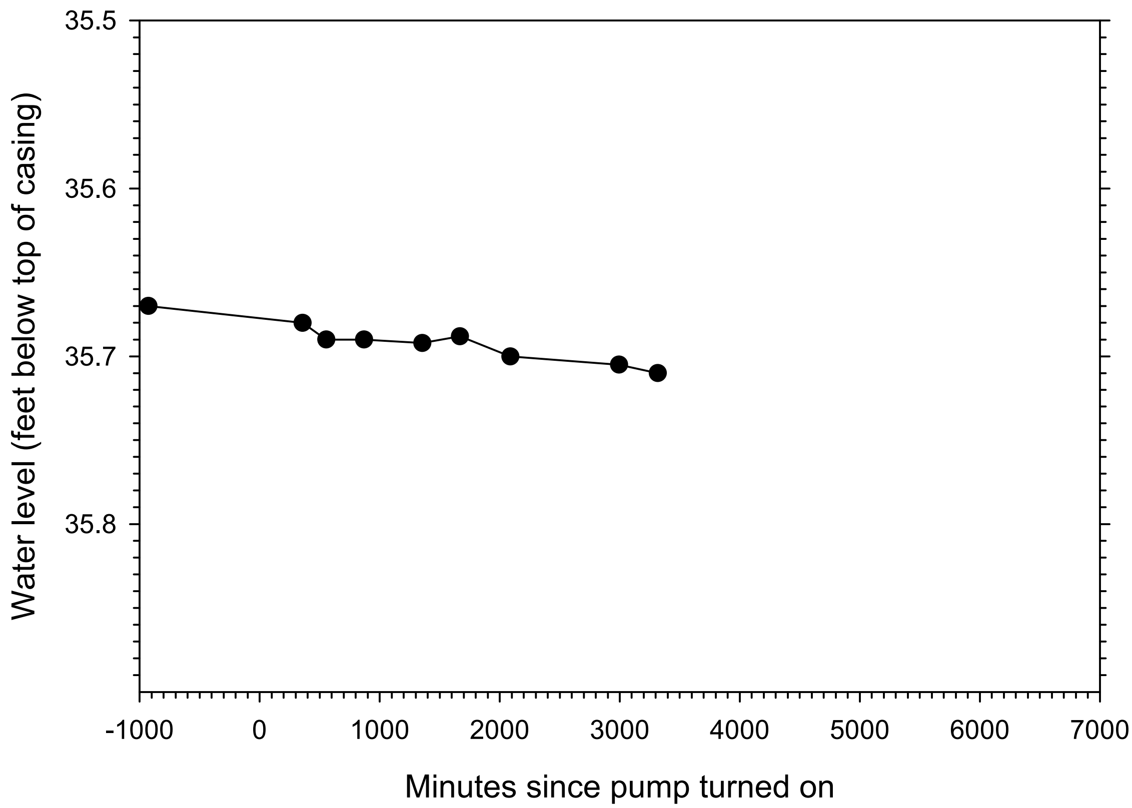
CN1-58 (water level)
31.1
31.2
31.3
Water level (feet below top of casing)
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN1-58**

Elevation TOC	6878.1	Feet
Static level:	31.16	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1150.98	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:08	-2242.0	31.18	0	6846.92
4/28/2016 18:15	-975.0	31.17	-0.01	6846.93
4/29/2016 10:20	-10.0	31.16	-0.02	6846.94
4/29/2016 10:46	16.7	31.16	-0.02	6846.94
4/29/2016 11:06	36.8	31.17	-0.01	6846.93
4/29/2016 11:39	69.5	31.17	-0.01	6846.93
4/29/2016 12:20	110.7	31.188	0.008	6846.912
4/29/2016 13:27	177.0	31.19	0.01	6846.91
4/29/2016 16:20	350.0	31.2	0.02	6846.9
4/29/2016 18:04	454.0	31.205	0.025	6846.895
4/29/2016 23:34	784.0	31.2	0.02	6846.9
4/30/2016 8:06	1296.0	31.22	0.04	6846.88
4/30/2016 14:38	1688.0	31.2	0.02	6846.9
4/30/2016 20:28	2038.0	31.215	0.035	6846.885
5/1/2016 13:58	3088.0	31.219	0.039	6846.881
5/1/2016 17:01	3271.0	31.228	0.048	6846.872
5/3/2016 14:05	5975.0	31.22	0.04	6846.88

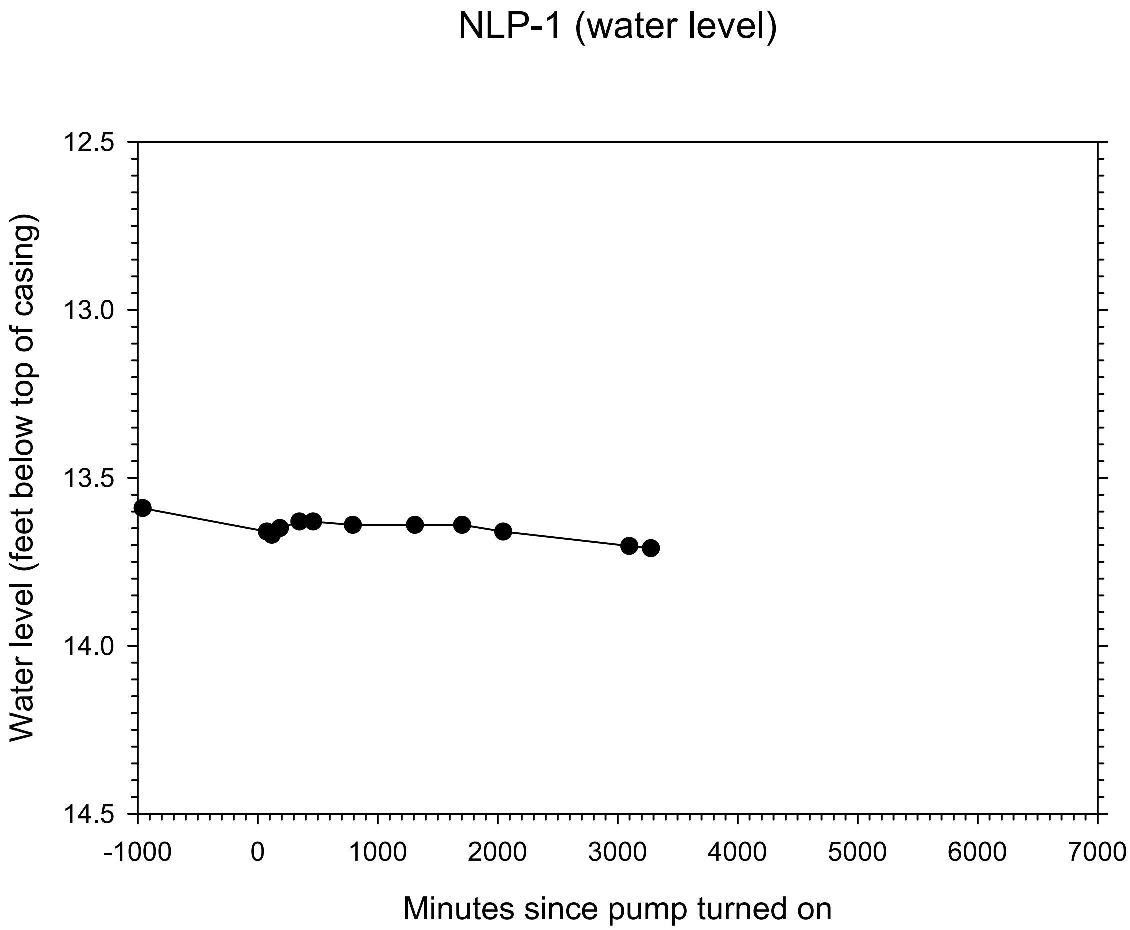
CN2-70 (water level)



Monitoring Well: **CN2-70**

Elevation TOC	6937.37	Feet
Static level:	35.67	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1270.40	Feet

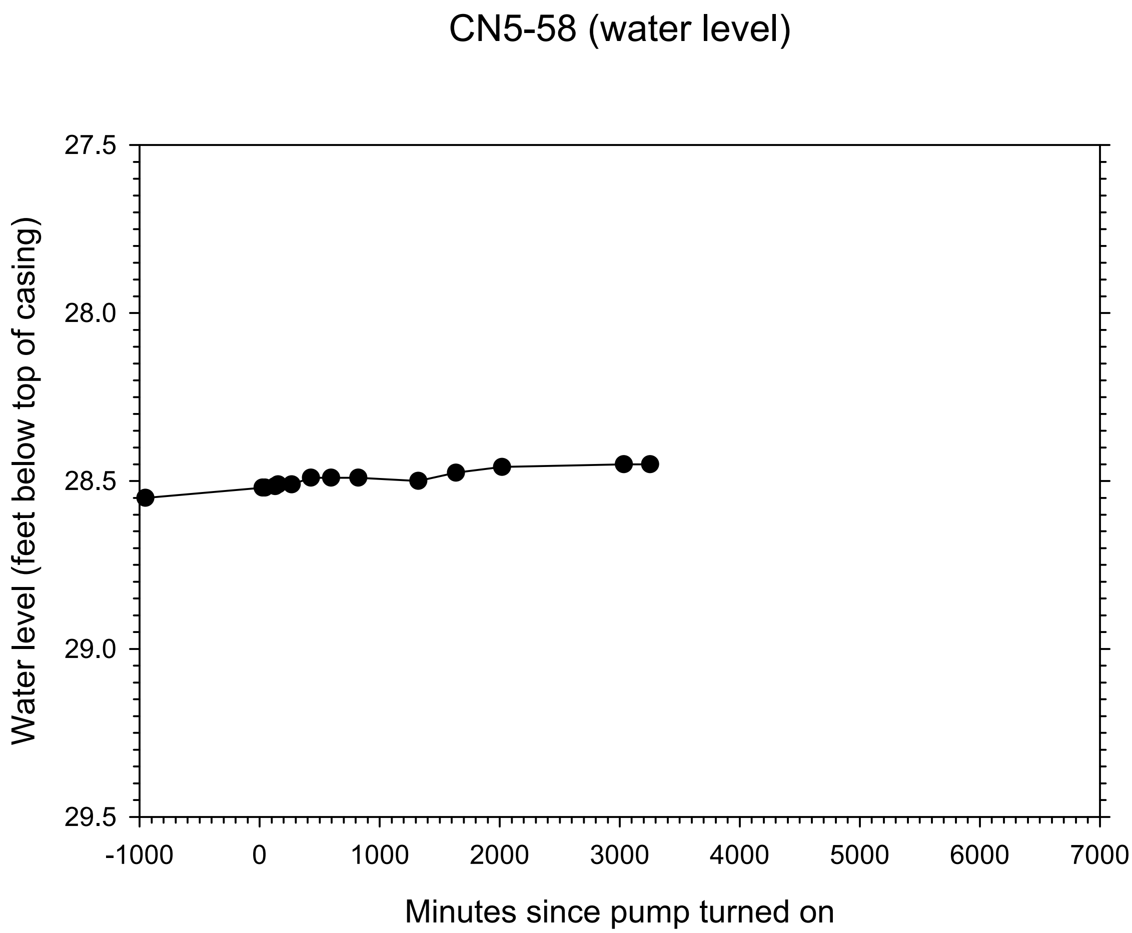
Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:49	-2201.0	35.67	0.00	6901.69
4/28/2016 19:03	-927.0	35.67	0.00	6901.69
4/29/2016 16:27	357.0	35.68	0.01	6901.68
4/29/2016 19:45	555.0	35.69	0.02	6901.67
4/30/2016 0:59	869.0	35.69	0.02	6901.67
4/30/2016 9:05	1355.0	35.692	0.02	6901.668
4/30/2016 14:18	1668.0	35.688	0.02	6901.672
4/30/2016 21:17	2087.0	35.7	0.03	6901.66
5/1/2016 12:23	2993.0	35.705	0.03	6901.655
5/1/2016 17:47	3317.0	35.71	0.04	6901.65


NLP-1 (water level)
Water level (feet below top of casing)
12.5
13.0
13.5
14.0
14.5
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **NLP-1**

Elevation TOC	6920.23	Feet
Static level:	13.59	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1297.25	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 22:32	-2158.0	13.57	-0.02	6906.66
4/28/2016 18:30	-960.0	13.59	0.00	6906.64
4/29/2016 11:46	76.3	13.66	0.07	6906.57
4/29/2016 12:27	117.8	13.67	0.08	6906.56
4/29/2016 13:34	184.0	13.65	0.06	6906.58
4/29/2016 16:16	346.0	13.63	0.04	6906.6
4/29/2016 18:11	461.0	13.63	0.04	6906.6
4/29/2016 23:42	792.0	13.64	0.05	6906.59
4/30/2016 8:20	1310.0	13.64	0.05	6906.59
4/30/2016 14:53	1703.0	13.64	0.05	6906.59
4/30/2016 20:35	2045.0	13.66	0.07	6906.57
5/1/2016 14:09	3099.0	13.703	0.11	6906.527
5/1/2016 17:08	3278.0	13.71	0.12	6906.52

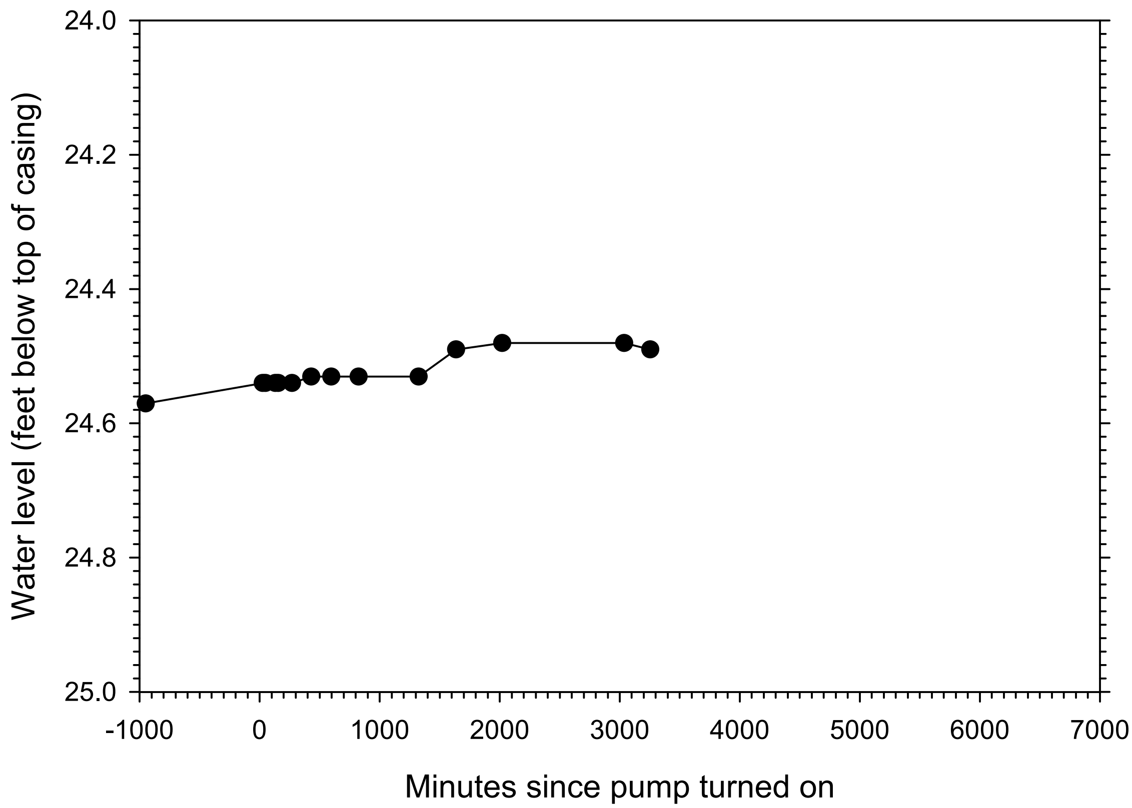

CN5-58 (water level)
Water level (feet below top of casing)
27.5
28.0
28.5
29.0
29.5
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN5-58**

Elevation TOC	6878.1	Feet
Static level:	28.55	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1345.37	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:40	-2270.0	28.58	0.03	6849.52
4/28/2016 18:38	-952.0	28.55	0.00	6849.55
4/29/2016 10:53	23.8	28.52	-0.03	6849.58
4/29/2016 11:14	44.5	28.52	-0.03	6849.58
4/29/2016 12:39	129.2	28.515	-0.04	6849.585
4/29/2016 13:03	153.0	28.51	-0.04	6849.59
4/29/2016 14:57	267.0	28.51	-0.04	6849.59
4/29/2016 17:37	427.0	28.49	-0.06	6849.61
4/29/2016 20:24	594.0	28.49	-0.06	6849.61
4/30/2016 0:11	821.0	28.49	-0.06	6849.61
4/30/2016 8:31	1321.0	28.5	-0.05	6849.6
4/30/2016 13:44	1634.0	28.475	-0.07	6849.625
4/30/2016 20:08	2018.0	28.458	-0.09	6849.642
5/1/2016 13:04	3034.0	28.45	-0.10	6849.65
5/1/2016 16:43	3253.0	28.45	-0.10	6849.65

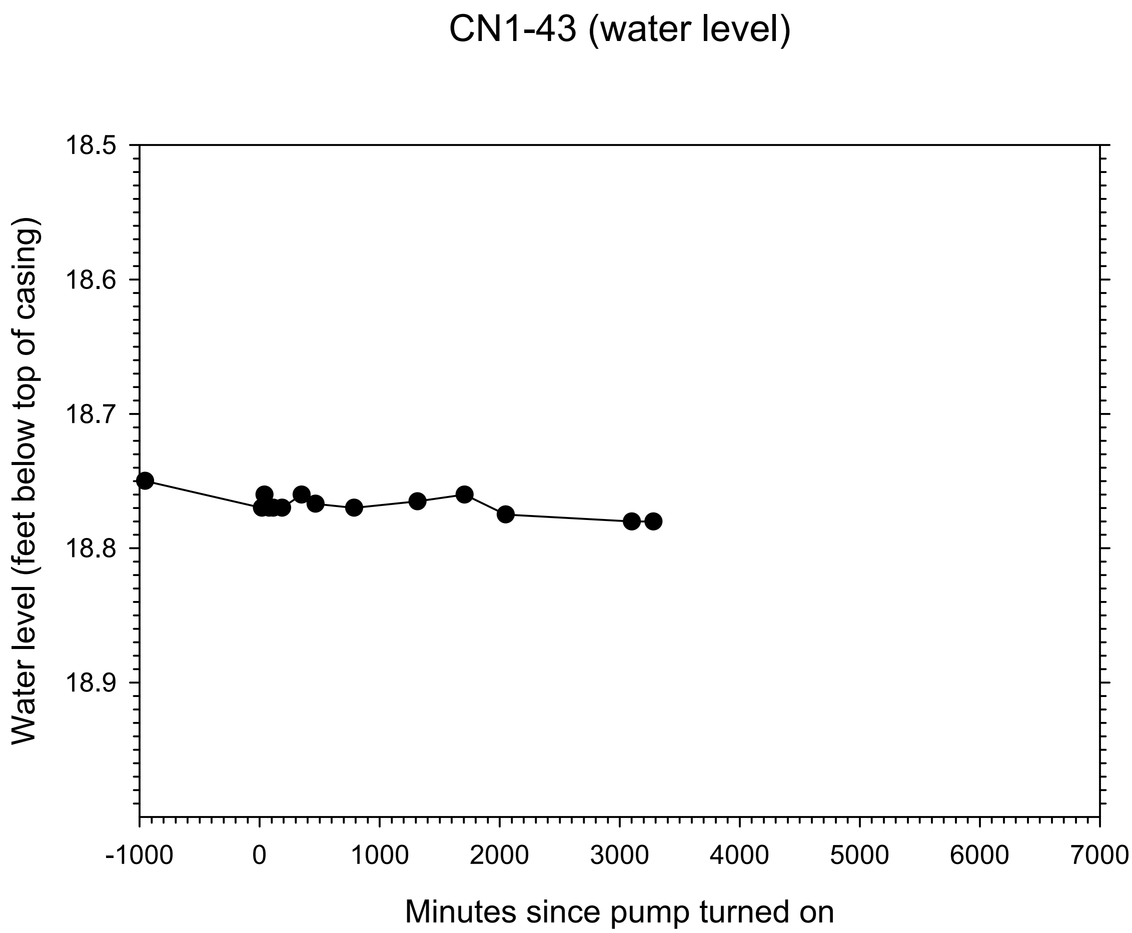
CN5-52 (water level)



Monitoring Well: **CN5-52**

Elevation TOC	6875.4	Feet
Static level:	24.54	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1380.57	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:42	-2268.0	24.62	0.08	6850.78
4/28/2016 18:40	-950.0	24.57	0.03	6850.83
4/29/2016 10:55	25.5	24.54	0.00	6850.86
4/29/2016 11:16	46.5	24.54	0.00	6850.86
4/29/2016 12:41	131.0	24.54	0.00	6850.86
4/29/2016 13:05	155.0	24.54	0.00	6850.86
4/29/2016 15:00	270.0	24.54	0.00	6850.86
4/29/2016 17:39	429.0	24.53	-0.01	6850.87
4/29/2016 20:26	596.0	24.53	-0.01	6850.87
4/30/2016 0:13	823.0	24.53	-0.01	6850.87
4/30/2016 8:34	1324.0	24.53	-0.01	6850.87
4/30/2016 13:46	1636.0	24.49	-0.05	6850.91
4/30/2016 20:10	2020.0	24.48	-0.06	6850.92
5/1/2016 13:07	3037.0	24.48	-0.06	6850.92
5/1/2016 16:46	3256.0	24.49	-0.05	6850.91

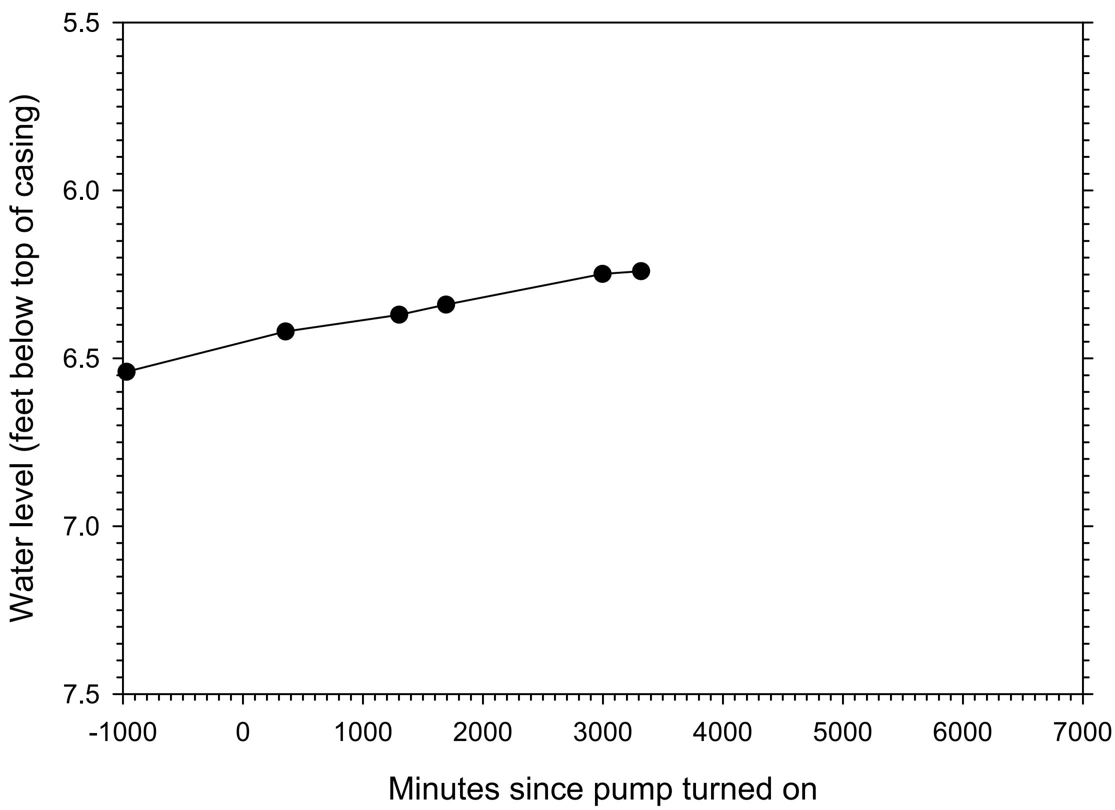

CN1-43 (water level)
Water level (feet below top of casing)
18.5
18.6
18.7
18.8
18.9
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN1-43**

Elevation TOC	6931.16	Feet
Static level:	18.75	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1460.31	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:11	-2239.0	18.74	-0.01	6912.42
4/28/2016 18:35	-955.0	18.75	0	6912.41
4/29/2016 10:48	18.5	18.77	0.02	6912.39
4/29/2016 11:08	38.7	18.76	0.01	6912.4
4/29/2016 11:49	79.3	18.77	0.02	6912.39
4/29/2016 12:23	113.0	18.77	0.02	6912.39
4/29/2016 13:37	187.0	18.77	0.02	6912.39
4/29/2016 16:20	350.0	18.76	0.01	6912.4
4/29/2016 18:15	465.0	18.767	0.017	6912.393
4/29/2016 23:37	787.0	18.77	0.02	6912.39
4/30/2016 8:24	1314.0	18.765	0.015	6912.395
4/30/2016 14:56	1706.0	18.76	0.01	6912.4
4/30/2016 20:38	2048.0	18.775	0.025	6912.385
5/1/2016 14:12	3102.0	18.78	0.03	6912.38
5/1/2016 17:11	3281.0	18.78	0.03	6912.38

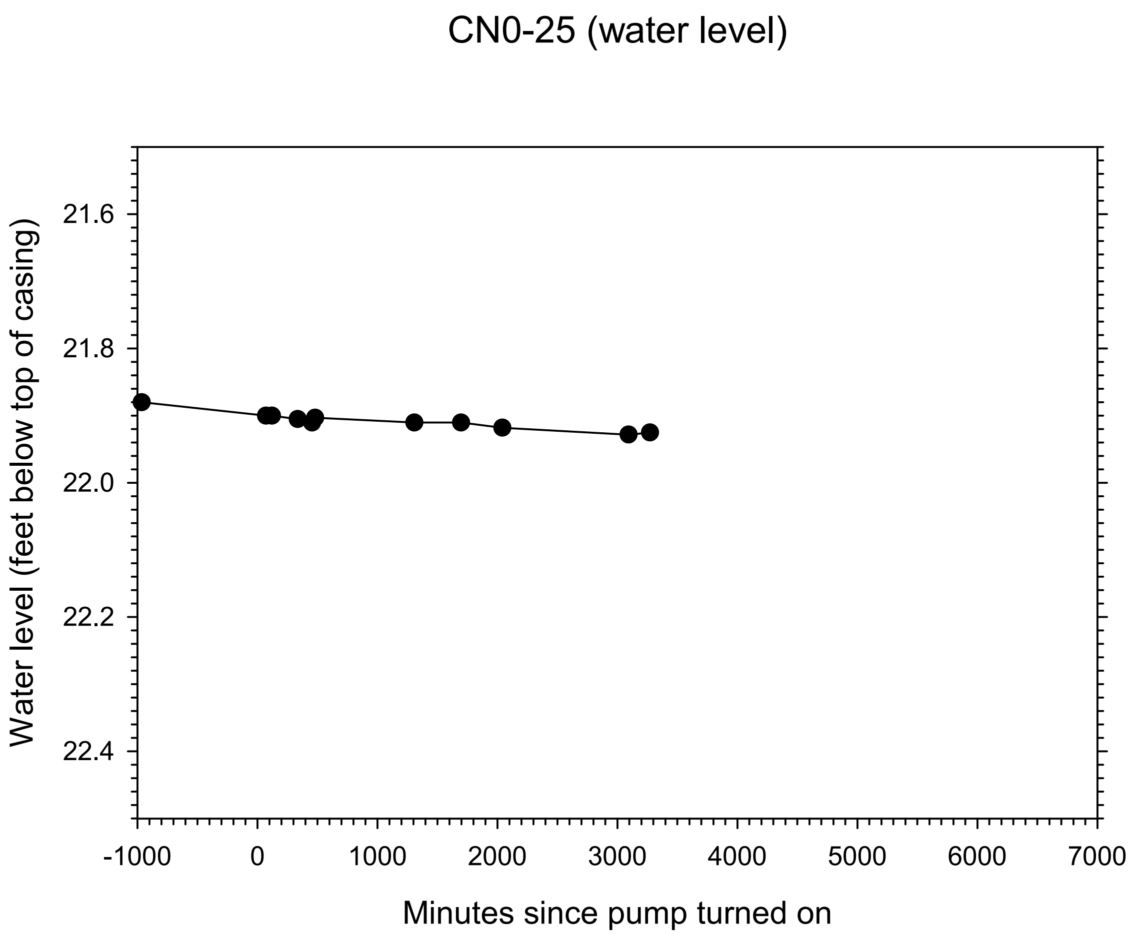
NLP-5 (water level)



Monitoring Well: **NLP-5**

Elevation TOC	6921.45	Feet
Static level:	6.54	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1674.23	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/28/2016 18:20	-970.0	6.54	0.00	6914.91
4/29/2016 16:24	354.0	6.42	-0.12	6915.03
4/30/2016 8:11	1301.0	6.37	-0.17	6915.08
4/30/2016 14:42	1692.0	6.34	-0.20	6915.11
5/1/2016 12:27	2997.0	6.248	-0.29	6915.202
5/1/2016 17:50	3320.0	6.24	-0.30	6915.21

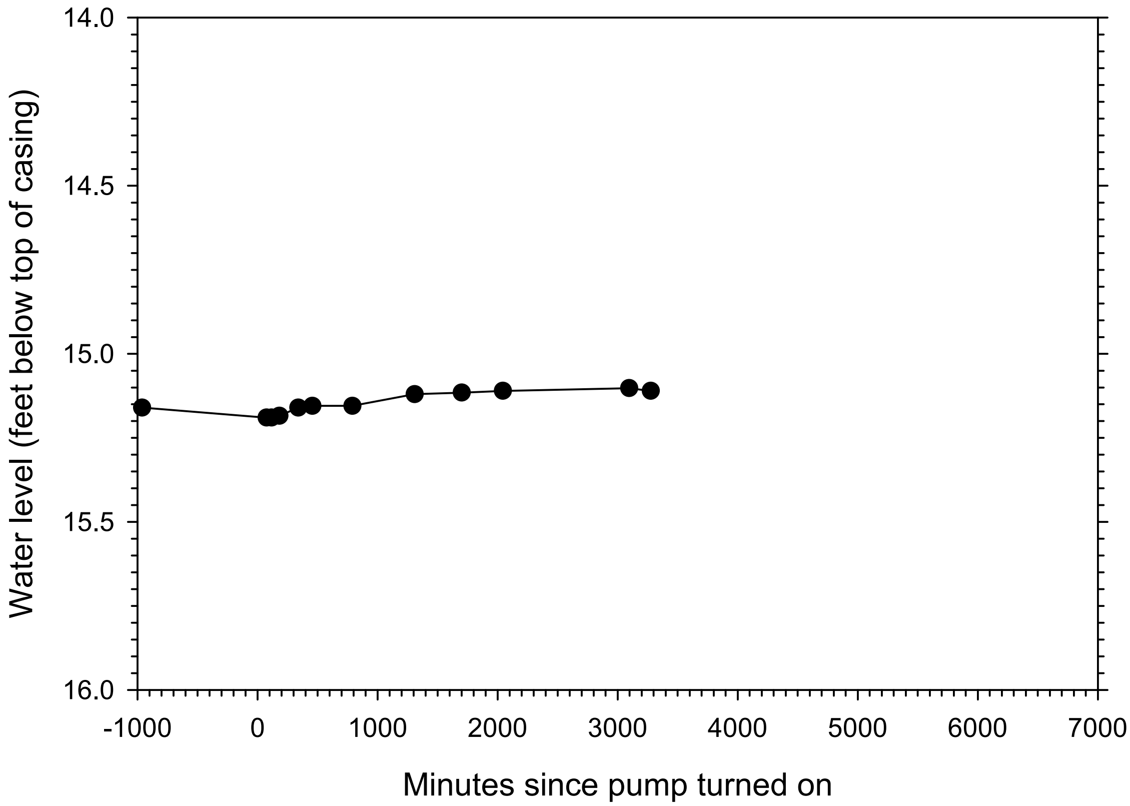

CN0-25 (water level)
Water level (feet below top of casing)
21.6
21.8
22.0
22.2
22.4
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN0-25**

Elevation TOC	6939.28	Feet
Static level:	21.88	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1774.34	Feet

Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:20	-2230.0	21.87	-0.01	6917.41
4/28/2016 18:25	-965.0	21.88	0.00	6917.4
4/29/2016 11:41	71.8	21.9	0.02	6917.38
4/29/2016 12:30	120.8	21.9	0.02	6917.38
4/29/2016 16:06	336.0	21.905	0.03	6917.375
4/29/2016 18:05	455.0	21.91	0.03	6917.37
4/29/2016 18:30	480.0	21.903	0.02	6917.377
4/30/2016 8:16	1306.0	21.91	0.03	6917.37
4/30/2016 14:47	1697.0	21.91	0.03	6917.37
4/30/2016 20:31	2041.0	21.918	0.04	6917.362
5/1/2016 14:04	3094.0	21.928	0.05	6917.352
5/1/2016 17:03	3273.0	21.925	0.05	6917.355

CN0-60 (water level)

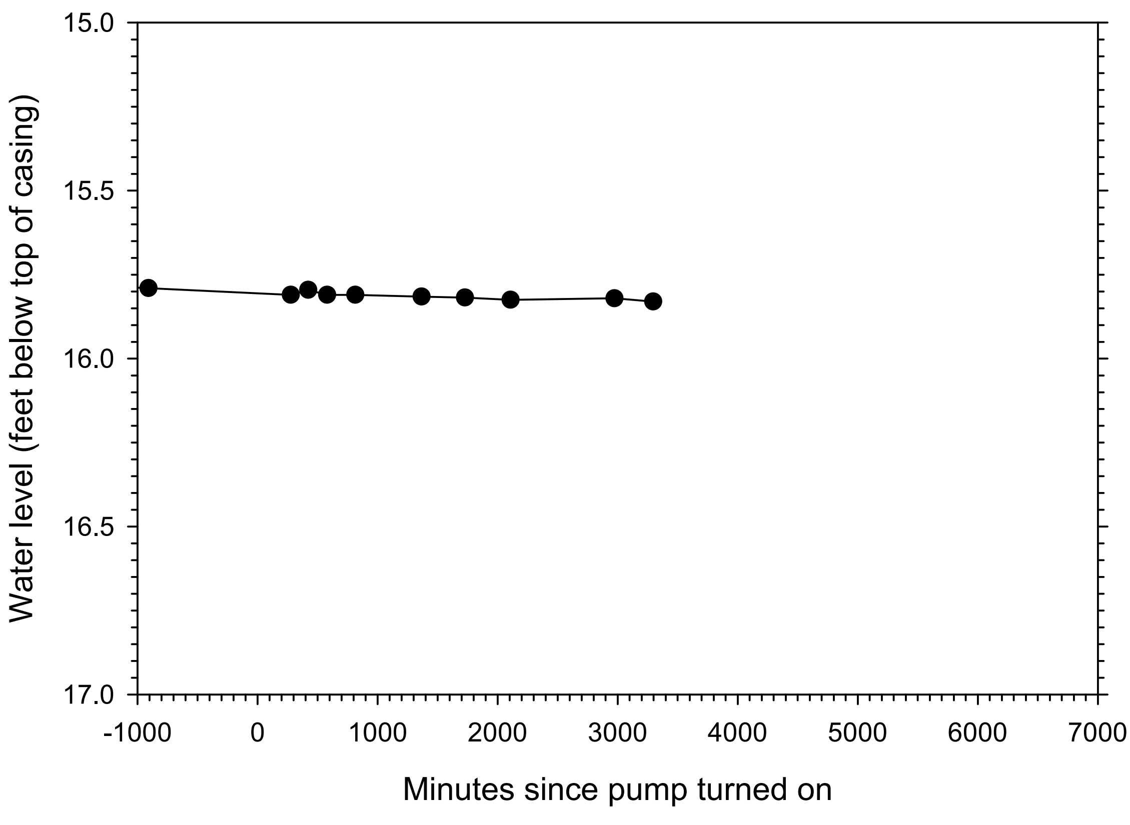


Monitoring Well: **CN0-60**

Elevation TOC	6932.16	Feet
Static level:	15.16	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	1849.52	Feet

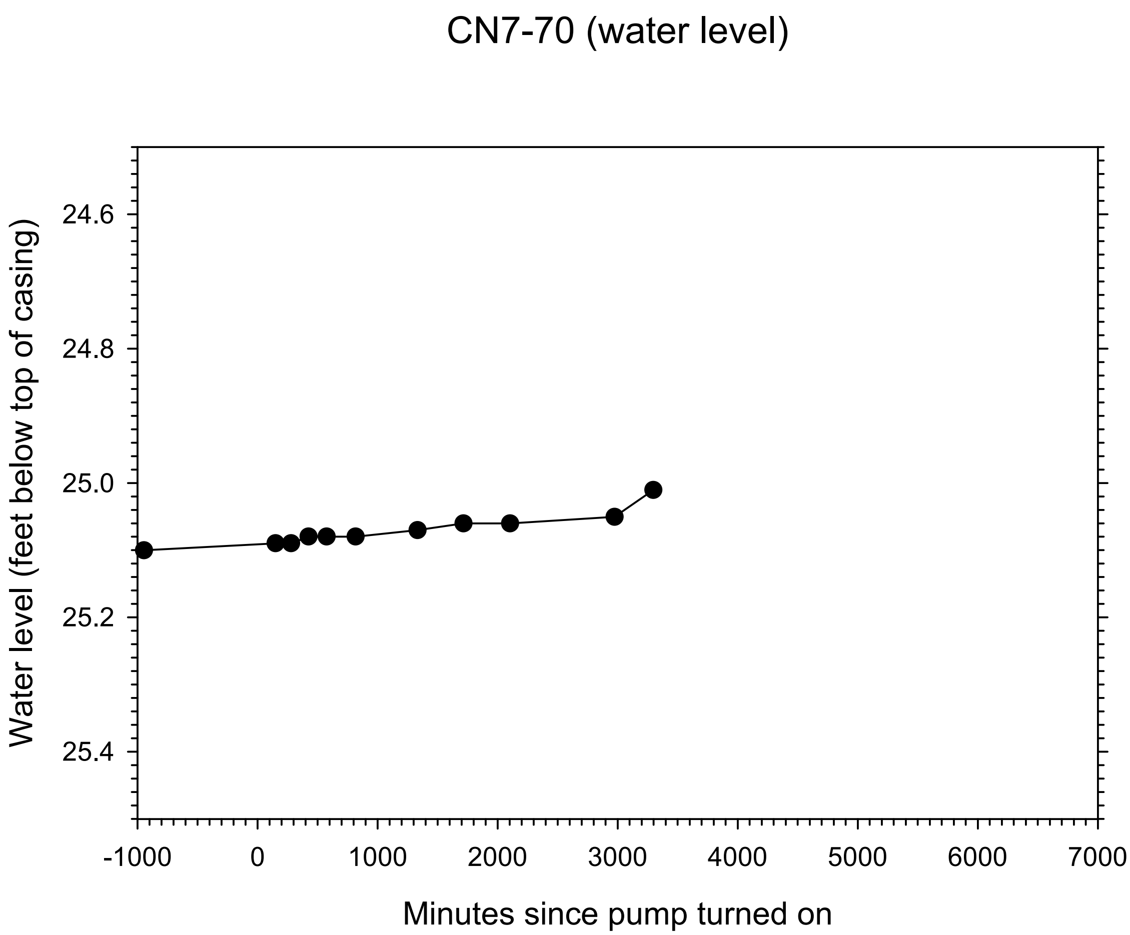
Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 21:15	-2235.0	15.16	0.00	6917
4/28/2016 18:27	-963.0	15.16	0.00	6917
4/29/2016 11:44	74.0	15.19	0.03	6916.97
4/29/2016 12:25	115.3	15.19	0.03	6916.97
4/29/2016 13:32	182.0	15.185	0.03	6916.975
4/29/2016 16:09	339.0	15.16	0.00	6917
4/29/2016 18:07	457.0	15.155	-0.01	6917.005
4/29/2016 23:40	790.0	15.155	-0.01	6917.005
4/30/2016 8:18	1308.0	15.12	-0.04	6917.04
4/30/2016 14:50	1700.0	15.115	-0.04	6917.045
4/30/2016 20:33	2043.0	15.11	-0.05	6917.05
5/1/2016 14:06	3096.0	15.102	-0.06	6917.058
5/1/2016 17:06	3276.0	15.11	-0.05	6917.05

NLP-12 (water level)



Monitoring Well:	**NLP-12**	
Elevation TOC	6848.57	Feet
Static level:	15.79	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	2055.98	Feet

Date and Time	**Elapsed minutes since pump on (minutes)**	**Depth to water (feet below toc)**	**Drawdown (feet)**	**Wat el. (feet)**
4/27/2016 22:00	-2190.0	15.77	-0.02	6832.8
4/28/2016 19:20	-910.0	15.79	0.00	6832.78
4/29/2016 15:06	276.0	15.81	0.02	6832.76
4/29/2016 17:32	422.0	15.795	0.01	6832.775
4/29/2016 20:09	579.0	15.81	0.02	6832.76
4/30/2016 0:04	814.0	15.81	0.02	6832.76
4/30/2016 9:16	1366.0	15.815	0.03	6832.755
4/30/2016 15:18	1728.0	15.818	0.03	6832.752
4/30/2016 21:37	2107.0	15.825	0.04	6832.745
5/1/2016 12:03	2973.0	15.82	0.03	6832.75
5/1/2016 17:26	3296.0	15.83	0.04	6832.74


CN7-70 (water level)
Water level (feet below top of casing)
24.6
24.8
25.0
25.2
25.4
-1000
0
1000
2000
3000
4000
5000
6000
7000
Minutes since pump turned on

Monitoring Well: **CN7-70**

Elevation TOC	6848.91	Feet
Static level:	25.10	(feet below toc)
Pump on:	4/29/2016 10:30	Time
Pump off	5/1/2016 18:30	Time
Pump dist.	2307.79	Feet

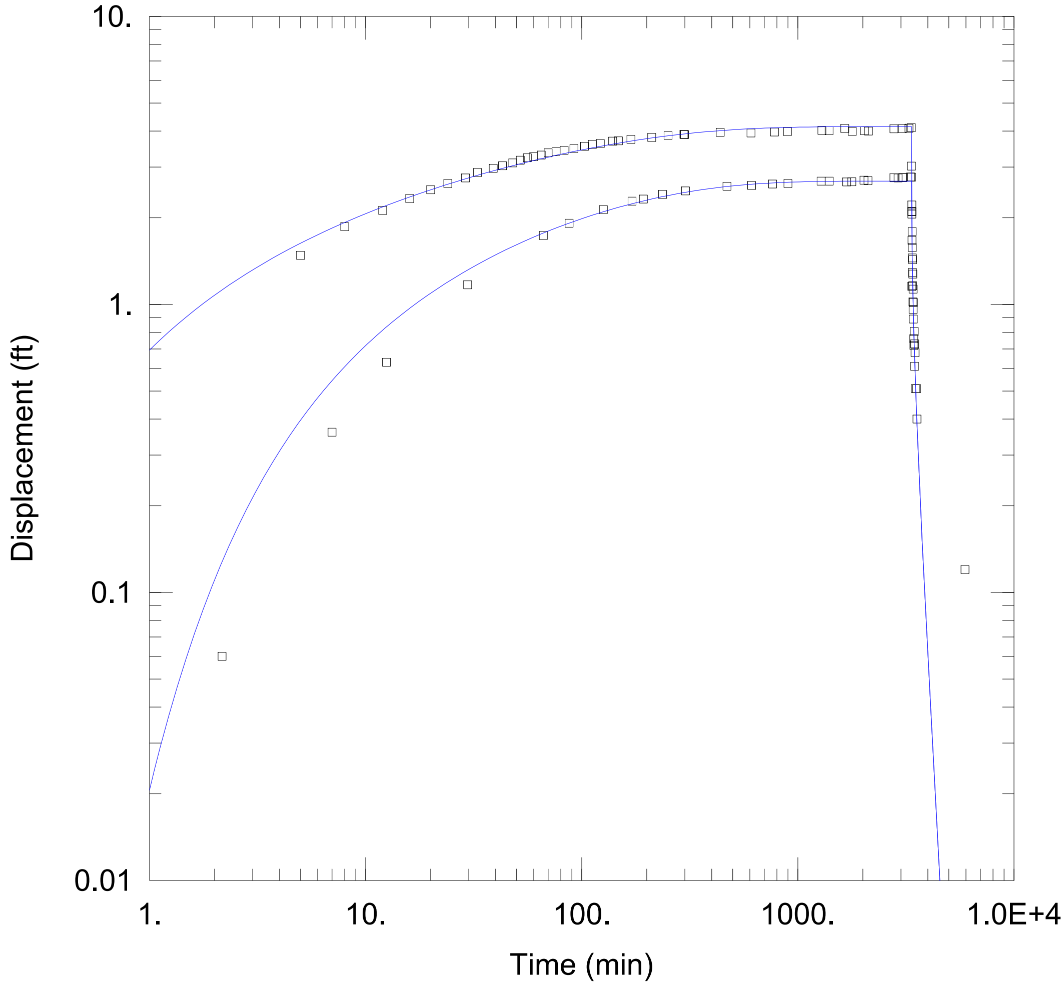
Date and Time	Elapsed minutes since pump on (minutes)	Depth to water (feet below toc)	Drawdown (feet)	Wat el. (feet)
4/27/2016 20:30	-2280.0	25.08	-0.02	6823.83
4/28/2016 18:43	-947.0	25.1	0.00	6823.81
4/29/2016 12:59	149.0	25.09	-0.01	6823.82
4/29/2016 15:09	279.0	25.09	-0.01	6823.82
4/29/2016 17:35	425.0	25.08	-0.02	6823.83
4/29/2016 20:05	575.0	25.08	-0.02	6823.83
4/30/2016 0:07	817.0	25.08	-0.02	6823.83
4/30/2016 8:42	1332.0	25.07	-0.03	6823.84
4/30/2016 15:04	1714.0	25.06	-0.04	6823.85
4/30/2016 21:33	2103.0	25.06	-0.04	6823.85
5/1/2016 12:06	2976.0	25.05	-0.05	6823.86
5/1/2016 17:28	3298.0	25.01	-0.09	6823.9

Attachment C

Alluvial groundwater system

2016 Aquifer pump test analysis results

(Aqtesolv v. 4.50.002)



WELL TEST ANALYSIS

Data Set: C:\...\Pump and two obs wells VX.aqt
Date: 06/20/16 Time: 15:12:38

PROJECT INFORMATION

Company: Petersen Hydrologic, LLC
Client: Alton Coal Development, LLC
Test Well: CN3-81
Test Date: 29 April 2016

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
CN3-81	1764206	364102

Observation Wells

Well Name	X (ft)	Y (ft)
□ CN3-69	1764043	364077
□ CN3-80	1764246	364066

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 666.9 ft^2/day
1/B = 0.0009133 ft^{-1}
b = 40. ft

S = 0.0001588
Kz/Kr = 1.

Data Set: C:\Users\Erik\Documents\AAA PH LLC\Coal Hollow\AAA North Lease Permitting\2016 Pump Testing\We
Date: 06/20/16
Time: 15:11:55

PROJECT INFORMATION

Company: Petersen Hydrologic, LLC
Client: Alton Coal Development, LLC
Test Date: 29 April 2016
Test Well: CN3-81

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b'): 20. ft
Aquitard Thickness (b"): 300. ft

PUMPING WELL DATA

No. of pumping wells: 1

Pumping Well No. 1: CN3-81

X Location: 1764206. ft
Y Location: 364102. ft

Casing Radius: 0.167 ft
Well Radius: 0.328 ft

Fully Penetrating Well

No. of pumping periods: 2

Pumping Period Data

Time (min)	Rate (gal/min)	Time (min)	Rate (gal/min)
0.	28.8	3360.	0.

OBSERVATION WELL DATA

No. of observation wells: 2

Observation Well No. 1: CN3-69

X Location: 1764043. ft
Y Location: 364077. ft

Radial distance from CN3-81: 164.9060338 ft

Fully Penetrating Well

No. of Observations: 39

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
2.167	0.06	2113.	2.69
7.	0.36	2785.	2.752
12.5	0.63	2910.	2.75
29.67	1.17	3051.	2.755
66.5	1.735	3070.	2.756
87.5	1.913	3331.	2.77
126.	2.135	3361.	2.765
171.	2.285	3372.5	2.1
193.	2.322	3382.	1.79
237.	2.41	3390.5	1.575
302.	2.478	3398.5	1.43
470.	2.573	3408.5	1.275

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
611.	2.59	3419.5	1.13
765.	2.62	3430.5	1.015
900.	2.63	3461.	0.805
1281.	2.68	3474.	0.73
1398.	2.68	3489.	0.68
1684.	2.663	3549.	0.51
1778.	2.665	5940.	-0.08
2025.	2.7		

Observation Well No. 2: CN3-80

X Location: 1764246. ft
Y Location: 364066. ft

Radial distance from CN3-81: 53.81449619 ft

Fully Penetrating Well

No. of Observations: 61

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
5.	1.48	780.	3.97
8.	1.86	896.	3.985
12.	2.12	1292.	4.02
16.	2.33	1395.	4.01
20.	2.5	1650.	4.08
24.	2.63	1788.	3.99
29.	2.75	2034.	4.008
33.	2.87	2125.	4.
39.	2.97	2783.	4.07
43.	3.03	3047.	4.075
48.	3.1	3268.	4.09
52.	3.17	3356.	4.11
56.	3.23	3362.5	3.02
60.	3.26	3369.	2.215
65.	3.3	3369.8	1.155
70.	3.36	3370.5	2.105
76.	3.39	3371.	2.06
83.	3.43	3379.5	1.67
92.	3.48	3387.	1.45
103.	3.54	3393.	1.29
112.	3.59	3401.	1.16
122.	3.62	3411.	1.02
139.	3.69	3416.8	0.96
148.	3.7	3424.	0.89
169.	3.74	3439.	0.76
211.	3.8	3448.	0.72
251.	3.86	3471.	0.61
297.	3.892	3500.	0.51
299.	3.889	3562.	0.4
438.	3.96	5935.	0.12
607.	3.94		

SOLUTION

Pumping Test
Aquifer Model: Leaky
Solution Method: Hantush-Jacob

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
T	666.9	ft^2/day

S	0.0001588	
1/B	0.0009133	ft^{-1}
Kz/Kr	1.	
b	40.	ft

K = T/b = 16.67 ft/day (0.005881 cm/sec)
Ss = S/b = 3.969E-6 1/ft
K'/b' = 3.863E-7 min^{-1}
K' = 0.01113 ft/day

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
T	666.9	14.54	+/- 28.86	45.86	ft^2/day
S	0.0001588	1.071E-5	+/- 2.126E-5	14.82	
1/B	0.0009133	5.723E-5	+/- 0.0001136	15.96	ft^{-1}
Kz/Kr	1.	not estimated			
b	40.	not estimated			ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

K = T/b = 16.67 ft/day (0.005881 cm/sec)
Ss = S/b = 3.969E-6 1/ft
K'/b' = 3.863E-7 min^{-1}
K' = 0.01113 ft/day

Parameter Correlations

	T	S	1/B
T	1.00	-0.88	-0.97
S	-0.88	1.00	0.89
1/B	-0.97	0.89	1.00

Residual Statistics

for weighted residuals

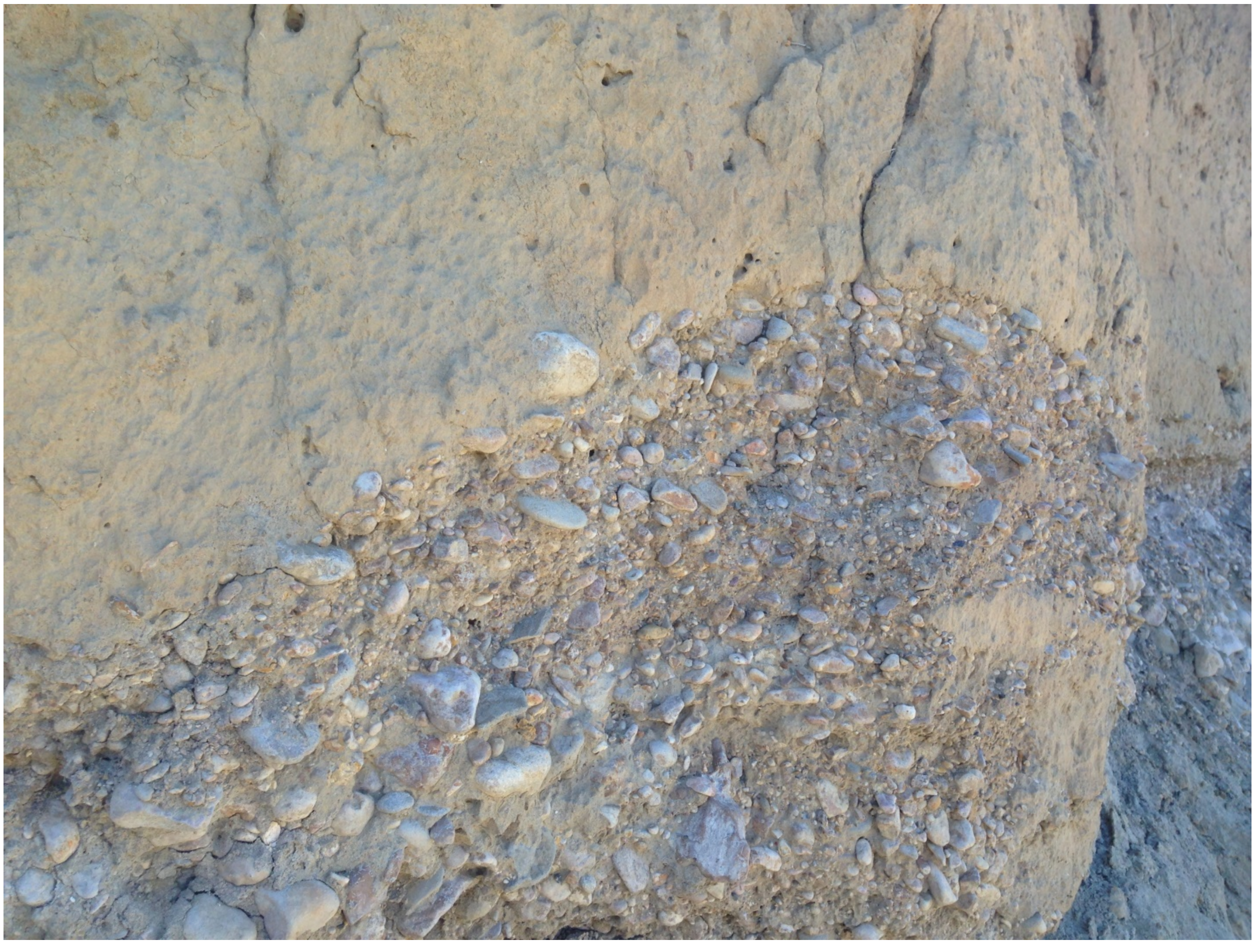
Sum of Squares . . . . . . 1.777 ft^2
Variance . . . . 0.01832 ft^2
Std. Deviation . . . . 0.1353 ft
Mean . . . . 0.005847 ft
No. of Residuals 100
No. of Estimates 3

Attachment D

Photographs Section

Photographs from the North Private Lease area

(2016)



Interbedded alluvial gravel and silty, clayey deposits in Kanab Creek stream bank.

Kanab Creek stream channel near pump test area – note presence of fine-grained (clayey, silty) deposits in the stream channel with the gravels and boulders.

Kanab Creek flowing through North Private Lease area under high flow conditions – March 2016.

Kanab Creek flowing through North Private Lease area under high flow conditions – March 2016.

Rotary drilling operation in the North Private Lease area – March 2016.

Direct-push drilling operation adjacent to Kanab Creek – March 2016.

Attachment E

Water quality analyses

From selected monitoring wells in the

North Private Lease area

Chemtech-Ford Laboratories

(2016)

Field measurements for March 2016 samples

Well	Date	Time	Wat. Lev. (ft b. toc)	T (°C)	pH (S.U.)	Sp. Conductance µS/cm)
CN2-70	22-Mar-16	11:50	34.99	10.6	7.05	2042
CN7-70	22-Mar-16	16:00	24.04	10.6	6.77	1984
CN5-58	22-Mar-16	16:50	27.85	10.1	6.84	1934
CN1-43	23-Mar-16	19:50	18.78	9.8	6.93	1678
CN1-58	23-Mar-16	20:40	30.58	9.4	7.01	2122
CN4-49	24-Mar-16	10:15	28.55	10.9	7.05	1865
CN3-98	24-Mar-16	15:15	26.55	11.3	7.01	1794
CN0-60	23-Mar-16	18:10	14.76	10	6.89	2083
CN0-25	23-Mar-16	18:30	22.01	Not enough water to sample		
CN6-1	24-Mar-16	11:00	26.00	Not enough water to sample		

CHEMTECH-FORD LABORATORIES

4/7/2016

Work Order: 16C1056

Alton Coal Development, LLC

Attn: Kirk Nicholes

463 North 100 West Ste 1

Cedar City, UT 84721

Client Service Contact: 801.262.7299

NELAP ACCREDITED TNI LABORATORY

Approved By: Dave Gayer, Laboratory Director

Certificate of Analysis

Lab Sample No.: 16C1056-01

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 11:50 AM
Sample Site:	CN2-70	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	28.1		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	-3.3		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	26.3		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1190	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	650	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	497	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	533	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	0.3	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	29	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	0.2	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	SPH
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 23:00	3/25/2016 23:00	SPH
Phosphorus, Total as P	0.03	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	800	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1620	20	mg/L	SM 2540 C	03/29/2016 07:00	3/29/2016 7:00	
Total Suspended Solids (TSS)	44	4	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 14:55	
Aluminum, Total	0.09	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Boron, Total	0.09	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Barium, Dissolved	0.036	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Calcium, Dissolved	188	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:11	
Iron, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	

9632 South 500 West
Sandy, UT 84070
801.262.7299 Office

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-01

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 11:50 AM
Sample Site:	CN2-70	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	0.70	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	176	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Manganese, Dissolved	0.290	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Manganese, Total	0.315	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:06	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:11	
Potassium, Dissolved	5.1	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 14:55	
Selenium, Total	0.47	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:03	
Sodium, Dissolved	53.3	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:25	
Zinc, Dissolved	0.01	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:11	

Certificate of Analysis

Lab Sample No.: 16C1056-02

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 4:00 PM
Sample Site:	CN7-70	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	26.9		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	-3.0		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	25.4		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1150	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	654	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	499	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	537	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	0.4	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	22	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	SPH
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 23:00	3/25/2016 23:00	SPH
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	750	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1550	20	mg/L	SM 2540 C	03/29/2016 07:00	3/29/2016 7:00	
Total Suspended Solids (TSS)	11	4	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 14:59	
Aluminum, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Boron, Total	0.05	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Barium, Dissolved	0.021	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Calcium, Dissolved	139	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:15	
Iron, Dissolved	0.11	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	

Certificate of Analysis

Lab Sample No.: 16C1056-02

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 4:00 PM
Sample Site:	CN7-70	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	1.28	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	194	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Manganese, Dissolved	0.145	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Manganese, Total	0.155	0.005	mg/L	EPA 200.7	03/28/2016 11:05	3/28/2016 18:43	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:15	
Potassium, Dissolved	5.2	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 14:59	
Selenium, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:55	
Sodium, Dissolved	53.4	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:29	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:15	

Certificate of Analysis

Lab Sample No.: 16C1056-03

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 4:50 PM
Sample Site:	CN5-58	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	26.1		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	0.9		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	26.6		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1240	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	653	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	492	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	535	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	0.3	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	16	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 23:00	3/25/2016 23:00	SPH
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	720	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1400	20	mg/L	SM 2540 C	03/29/2016 07:00	3/29/2016 7:00	
Total Suspended Solids (TSS)	13	4	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:03	
Aluminum, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Boron, Dissolved	0.06	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Boron, Total	0.10	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Barium, Dissolved	0.019	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Calcium, Dissolved	149	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:18	
Iron, Dissolved	0.28	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	

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Certificate of Analysis

Lab Sample No.: 16C1056-03

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/22/2016 4:50 PM
Sample Site:	CN5-58	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	0.98	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	210	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Manganese, Dissolved	0.216	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Manganese, Total	0.193	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:18	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:18	
Potassium, Dissolved	5.7	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:03	
Selenium, Total	0.40	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:07	
Sodium, Dissolved	39.3	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:33	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:18	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-04

Name:	Alton Coal Development, LLC	**Sample Date:**	3/23/2016 7:50 PM
Sample Site:	CN1-43	**Receipt Date:**	3/25/2016 2:50 PM
Comments:		**Sampler:**	Erik Petersen
Sample Matrix:	Water	**Site No.:**	
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	
PO Number:		**Project:**	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	22.0		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	2.6		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	23.2		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1020	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	817	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	649	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	670	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	26	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 18:00	3/25/2016 18:00	
Phosphorus, Total as P	0.05	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	380	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1120	20	mg/L	SM 2540 C	03/30/2016 16:08	3/30/2016 16:08	
Total Suspended Solids (TSS)	68	5	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:07	
Aluminum, Total	0.4	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Boron, Total	0.05	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Barium, Dissolved	0.032	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Calcium, Dissolved	161	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:22	
Iron, Dissolved	0.02	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	

Certificate of Analysis

Lab Sample No.: 16C1056-04

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/23/2016 7:50 PM
Sample Site:	CN1-43	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	3.30	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	151	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Manganese, Dissolved	0.271	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Manganese, Total	0.259	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:21	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:22	
Potassium, Dissolved	5.3	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:07	
Selenium, Total	0.38	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:10	
Sodium, Dissolved	60.4	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:36	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:22	

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Lab Sample No.: 16C1056-05

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/23/2016 8:40 PM
Sample Site:	CN1-58	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	29.1		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	-4.3		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	26.7		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1270	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	712	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	537	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	584	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	14	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 18:00	3/25/2016 18:00	
Phosphorus, Total as P	0.02	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	820	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1720	20	mg/L	SM 2540 C	03/30/2016 16:08	3/30/2016 16:08	
Total Suspended Solids (TSS)	32	4	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:10	
Aluminum, Total	0.07	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Boron, Total	0.07	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Barium, Dissolved	0.020	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Calcium, Dissolved	211	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:25	
Iron, Dissolved	0.02	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	

Certificate of Analysis

Lab Sample No.: 16C1056-05

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/23/2016 8:40 PM
Sample Site:	CN1-58	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	0.62	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	180	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Manganese, Dissolved	0.203	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Manganese, Total	0.221	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:25	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:25	
Potassium, Dissolved	4.9	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:10	
Selenium, Total	0.55	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:14	
Sodium, Dissolved	28.5	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:40	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:25	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-06

Name:	Alton Coal Development, LLC	***Sample Date:***	3/24/2016 10:15 AM
Sample Site:	CN4-49	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	24.8		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	1.1		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	25.3		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1140	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	672	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	547	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	551	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	0.6	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	23	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 23:00	3/25/2016 23:00	
Phosphorus, Total as P	0.01	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	630	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1450	20	mg/L	SM 2540 C	03/30/2016 16:08	3/30/2016 16:08	
Total Suspended Solids (TSS)	96	10	mg/L	SM 2540 D	03/30/2016 10:00	3/30/2016 10:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:14	
Aluminum, Total	0.3	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Boron, Dissolved	0.08	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Boron, Total	0.12	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Barium, Dissolved	0.035	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Calcium, Dissolved	161	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:29	
Iron, Dissolved	0.46	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	

Certificate of Analysis

Lab Sample No.: 16C1056-06

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/24/2016 10:15 AM
Sample Site:	CN4-49	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	3.31	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	180	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Manganese, Dissolved	0.088	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Manganese, Total	0.092	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:29	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:29	
Potassium, Dissolved	5.7	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:14	
Selenium, Total	0.35	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:17	
Sodium, Dissolved	52.9	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:44	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:29	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-07

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/24/2016 3:15 PM
Sample Site:	CN3-98	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	24.7		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	-1.4		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	24.0		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1110	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	672	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	504	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	552	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	0.5	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	20	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 19:00	3/25/2016 19:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 23:00	3/25/2016 23:00	
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	630	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1340	20	mg/L	SM 2540 C	03/31/2016 10:16	3/31/2016 10:16	
Total Suspended Solids (TSS)	6	4	mg/L	SM 2540 D	03/30/2016 10:00	3/30/2016 10:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:18	
Aluminum, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Boron, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Barium, Dissolved	0.019	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Calcium, Dissolved	177	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:33	
Iron, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	

Certificate of Analysis

Lab Sample No.: 16C1056-07

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/24/2016 3:15 PM
Sample Site:	CN3-98	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	163	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Manganese, Dissolved	0.642	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Manganese, Total	0.609	0.005	mg/L	EPA 200.7	03/28/2016 11:05	3/28/2016 18:46	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:33	
Potassium, Dissolved	4.7	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:18	
Selenium, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:05	3/29/2016 20:59	
Sodium, Dissolved	37.1	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:48	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:33	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-08

Name:	Alton Coal Development, LLC	***Sample Date:***	3/23/2016 6:10 PM
Sample Site:	CN0-60	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	28.9		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cation/Anion Balance	-1.0		%	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Cations, Total	28.3		meq/L	SM 1030 E	04/06/2016 09:01	4/6/2016 9:03	
Hardness, Dissolved as CaCO3	1270	1	mg/L	SM 2340 B	04/06/2016 09:01	4/6/2016 9:11	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	04/01/2016 11:35	4/1/2016 11:35	
Alkalinity - Bicarbonate (HCO3)	1020	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - CO2	791	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Alkalinity - Total (as CaCO3)	841	1.0	mg/L	SM 2320 B	03/31/2016 12:48	3/31/2016 12:48	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	03/31/2016 08:30	3/31/2016 8:30	
Chloride	32	1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Fluoride	0.4	0.1	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Nitrate as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 18:00	3/25/2016 18:00	
Nitrite as N	ND	0.1	mg/L	EPA 300.0	03/25/2016 18:00	3/25/2016 18:00	
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	03/31/2016 15:00	4/3/2016 12:30	
Sulfate	540	10	mg/L	EPA 300.0	03/25/2016 17:00	3/25/2016 17:00	
Total Dissolved Solids (TDS)	1380	20	mg/L	SM 2540 C	03/30/2016 16:08	3/30/2016 16:08	
Total Suspended Solids (TSS)	42	5	mg/L	SM 2540 D	03/29/2016 08:00	3/29/2016 8:00	
Metals							
Aluminum, Dissolved	ND	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:22	
Aluminum, Total	0.1	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Boron, Dissolved	0.08	0.05	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Boron, Total	0.13	0.05	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Barium, Dissolved	0.050	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Calcium, Dissolved	122	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:36	
Iron, Dissolved	0.27	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16C1056-08

Name:	**Alton Coal Development, LLC**	***Sample Date:***	3/23/2016 6:10 PM
Sample Site:	CN0-60	***Receipt Date:***	3/25/2016 2:50 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Private Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Total	3.81	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Lead, Total	ND	0.02	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	03/28/2016 10:35	3/29/2016 9:30	
Magnesium, Dissolved	235	0.2	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Manganese, Dissolved	0.123	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Manganese, Total	0.131	0.005	mg/L	EPA 200.7	03/28/2016 08:30	4/1/2016 18:33	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:36	
Potassium, Dissolved	3.8	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	03/28/2016 11:11	3/30/2016 15:22	
Selenium, Total	0.24	0.20	mg/L	EPA 200.7	03/28/2016 08:30	4/4/2016 15:21	
Sodium, Dissolved	63.7	0.5	mg/L	EPA 200.7	03/28/2016 11:11	3/29/2016 22:51	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	03/28/2016 11:11	3/28/2016 20:36	

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF COUSTODY

COMPANY: Alton Coal Development, LLC
ADDRESS:
CITY/STATE/ZIP: Cedar City, UT
PHONE #: FAX:
CONTACT: Kirk Nicholes PROJECT:
EMAIL: knicholes@altoncoal.com

BILLING ADDRESS:
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #: North Private Lease BASELINE

CHEMTECH-FORD LABORATORIES

TURNAROUND REQUIRED:*
* Expedited turnaround subject to additional charge

___ Mark 'X' here if you want a copy sent to DEQ Division of Drinking Water.

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

ANALYTICAL TESTS REQUESTED: SEE ATTACHED @ 03.28.16

Bacteriological: FIELD: Residual Chlorine; Total Coliform + E. coli (Present/Absent); Total Coliform + E. coli (Enumerated); HPC (Plate Count); E. coli only; WW: Total Coliform + Fecal Coliform

R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID # C1056	SAMPLE NAME	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	Repeat (Fail #)	SYSTEM #
01	1. CN 2-70	22Mar16	11:50			
02	2. CN 7-70	22Mar16	16:00			
03	3. CN5-58	22Mar16	16:50			
04	4. CN1-43	23Mar16	19:50			
05	5. CN1-58	23Mar16	20:40			
06	6. CN4-49	24Mar16	10:15			
07	7. CN 3-98	24Mar16	15:15			
08	8. CN0-60	23Mar16	18:10			
	9.					
	10.					

Sampled by: [print] Erik Petersen
Sampled by: [signature]

ON ICE NOT ON ICE 2.3

Special Instructions:

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
Relinquished by: [signature]	3/25/2016 14:00	Received by: [signature]	3-25-16 14:00
Relinquished by: [signature]	3-25-16 14:50	Received by: [signature]	3/26/16 1450
Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time 25 @ 03.28.16

CHEMTECH-FORD 6100 South Stratler Street (380 West) Murray, UT 84107 Phone: 801-262-7299 FAX: 801-262-7378 www.chemtechford.com

Payment Terms are net 30 days OAC. 1.5% interest charge per month (18% per annum). Client agress to pay collection costs and attorney's fees.

Alton Coal Development samples for 3/25/2016 drop off

Sample ID	Date	Time	Parameter list requested	Billing Project
SP-14	23-Mar-16	13:30	Alton Qtr GW	Coal Hollow Mine quarterly monitoring
UR-70	23-Mar-16	15:45	Alton Qtr GW	Coal Hollow Mine quarterly monitoring
CN2-70	22-Mar-16	11:50	Alton BGW	North Private Lease Baseline
CN7-70	22-Mar-16	16:00	Alton BGW	North Private Lease Baseline
CN5-58	22-Mar-16	16:50	Alton BGW	North Private Lease Baseline
CN0-60	23-Mar-16	18:10	Alton BGW	North Private Lease Baseline
CN1-43	23-Mar-16	19:50	Alton BGW	North Private Lease Baseline
CN1-58	23-Mar-16	20:40	Alton BGW	North Private Lease Baseline
CN4-49	24-Mar-16	10:15	Alton BGW	North Private Lease Baseline
CN3-98	24-Mar-16	15:15	Alton BGW	North Private Lease Baseline

Work Order # C1056

CHEMTECH FORD LABORATORIES

Sample Receipt

CHEMTECH-FORD LABORATORIES

Delivery Method:

- ☐ UPS ☐ USPS
- ☐ FedEx ☐ Chemtech Courier
- ☑ Walk-in ☐ Customer Courier

Receiving Temperature 23 °C

Sample #	Container	Chemtech Lot # Preservative	Number of Subsamples	Preserved by Client/Third Party	Preserved in Receiving/Laboratory	Filtered in Field by Client	Misc. Volume (mL)	Comments
01-04	AQ							
	M	670						
	N	669						
05-06	AQ							
	M	537						
	N	669						
07	AQ							
	M	604						
	N	669						
08	AQ							
	M	670						
	N	669						

Sample Condition (check if *yes*)

- ☐ Custody Seals
- ☑ Containers Intact
- ☑ COC/Labels Agree
- ☑ Preservation Confirmed
- ☑ Received on Ice
- ☑ Correct Containers(s)
- ☑ Sufficent Sample Volume
- ☐ Headspace Present (VOC)
- ☐ Temperature Blank
- ☑ Received within Holding Time

Plastic Containers

- A- Plastic Unpreserved
- B- Miscellaneous Plastic
- C- Cyanide Qt (NaOH)
- E- Coliform/Ecoli/HPC
- F- Sulfide Qt (Zn Acetate)
- L- Mercury 1631
- M- Metals Pint (HNO3)
- N- Nutrient Pint (H2SO4)
- R- Radiological (HNO3)
- S- Sludge Cups/Tubs
- Q- Plastic Bag

Glass Containers

- D- 625 (Na2S2O3)
- G- Glass Unpreserved
- H- HAAs (NH4Cl)
- J- 508/515/525 (Na2SO3)
- K- 515.3 Herbicides
- O- Oil & Grease (HCl)
- P- Phenols (H2SO4)
- T- TOC/TOX (H3PO4)
- U- 531 (MCAA, Na2S2O3)
- V- 524/THMs (Ascorbic Acid)
- W- 8260 VOC (1:1 HCl)
- X- Vial Unpreserved
- Y- 624/504 (Na2S2O3)
- Z- Miscellaneous Glass

Report Footnotes

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

Additional Report Information

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

Chemtech-Ford Contact Information

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CHEMTECH-FORD
LABORATORIES

6/22/2016

Work Order: 16F0483

Alton Coal Development, LLC

Attn: Kirk Nicholes

463 North 100 West Ste 1

Cedar City, UT 84721

Client Service Contact: 801.262.7299

Approved By:

Dave Gayer, Laboratory Director

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16F0483-01

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/6/2016 8:50 PM
Sample Site:	CN2-70	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	260
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	28.2		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	3.7		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	30.4		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1410	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	634	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - CO2	473	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Total (as CaCO3)	520	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Ammonia as N	0.5	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	28	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	0.02	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	820	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1690	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	24	7	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Aluminum, Total	0.5	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Boron, Dissolved	0.09	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Boron, Total	0.09	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Barium, Dissolved	0.015	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Calcium, Dissolved	223	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	

Certificate of Analysis

CHEMTECH-FORD LABORATORIES

Lab Sample No.: 16F0483-01

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/6/2016 8:50 PM
Sample Site:	CN2-70	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	260
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.05	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Iron, Total	0.92	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	207	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Manganese, Dissolved	0.491	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Manganese, Total	0.461	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Potassium, Dissolved	4.7	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 19:49	
Selenium, Total	0.06	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:53	
Sodium, Dissolved	48.2	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:29	

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Certificate of Analysis

Lab Sample No.: 16F0483-02

Name:	Alton Coal Development, LLC	***Sample Date:***	6/6/2016 9:30 PM
Sample Site:	CN4-49	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	261
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	25.4		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	1.1		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	26.0		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1190	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	698	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - CO2	521	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Total (as CaCO3)	573	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Ammonia as N	0.7	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	22	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	0.02	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	640	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1420	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	56	20	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Aluminum, Total	0.6	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Boron, Dissolved	0.12	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Boron, Total	0.14	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Barium, Dissolved	0.022	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Calcium, Dissolved	170	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16F0483-02

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/6/2016 9:30 PM
Sample Site:	CN4-49	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	261
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.08	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Iron, Total	4.56	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	187	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Manganese, Dissolved	0.075	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Manganese, Total	0.084	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Potassium, Dissolved	5.7	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 19:53	
Selenium, Total	0.06	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:22	
Sodium, Dissolved	44.4	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:33	

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Certificate of Analysis

CHEMTECH-FORD LABORATORIES

Lab Sample No.: 16F0483-03

Name:	Alton Coal Development, LLC	**Sample Date:**	6/6/2016 10:10 PM
Sample Site:	CN7-70	**Receipt Date:**	6/8/2016 2:11 PM
Comments:		**Sampler:**	Erik Petersen
Sample Matrix:	Water	**Site No.:**	262
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	
PO Number:		**Project:**	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	26.2		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	3.2		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	27.9		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1280	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	626	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - CO2	453	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Total (as CaCO3)	513	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Ammonia as N	0.5	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	19	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	740	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1560	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	7	7	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Aluminum, Total	0.1	0.05	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Boron, Dissolved	0.09	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Boron, Total	0.07	0.05	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Barium, Dissolved	0.014	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Calcium, Dissolved	155	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	

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Certificate of Analysis

Lab Sample No.: 16F0483-03

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/6/2016 10:10 PM
Sample Site:	CN7-70	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	262
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.26	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Iron, Total	1.71	0.02	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	216	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Manganese, Dissolved	0.136	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Manganese, Total	0.119	0.005	mg/L	EPA 200.7	06/13/2016 13:05	6/13/2016 20:42	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Potassium, Dissolved	5.3	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 19:56	
Selenium, Total	0.05	0.02	mg/L	EPA 200.7	06/13/2016 13:05	6/14/2016 15:32	
Sodium, Dissolved	51.5	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:37	

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Certificate of Analysis

Lab Sample No.: 16F0483-04

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 9:00 AM
Sample Site:	CN5-58	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	263
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	25.4		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	-5.8		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	22.7		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1060	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	664	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - CO2	489	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Alkalinity - Total (as CaCO3)	544	1.0	mg/L	SM 2320 B	06/16/2016 08:53	6/16/2016 9:27	
Ammonia as N	0.3	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	15	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	680	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1530	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	11	7	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Aluminum, Total	0.2	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Boron, Dissolved	0.08	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Boron, Total	0.11	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Barium, Dissolved	0.013	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Calcium, Dissolved	129	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	

Certificate of Analysis

CHEMTECH-FORD LABORATORIES

Lab Sample No.: 16F0483-04

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 9:00 AM
Sample Site:	CN5-58	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	263
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.67	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Iron, Total	1.43	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	180	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Manganese, Dissolved	0.157	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Manganese, Total	0.181	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Potassium, Dissolved	4.5	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 20:00	
Selenium, Total	0.06	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:26	
Sodium, Dissolved	29.2	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:41	

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Lab Sample No.: 16F0483-05

Name:	Alton Coal Development, LLC	**Sample Date:**	6/7/2016 9:40 AM
Sample Site:	CN3-98	**Receipt Date:**	6/8/2016 2:11 PM
Comments:		**Sampler:**	Erik Petersen
Sample Matrix:	Water	**Site No.:**	264
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	
PO Number:		**Project:**	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	24.6		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	-0.2		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	24.4		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1150	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	641	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - CO2	485	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Total (as CaCO3)	526	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Ammonia as N	0.5	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	19	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	0.02	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	650	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1360	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	21	7	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Aluminum, Total	0.5	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Boron, Dissolved	0.06	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Boron, Total	0.08	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Barium, Dissolved	0.015	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Calcium, Dissolved	183	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	

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Certificate of Analysis

Lab Sample No.: 16F0483-05

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 9:40 AM
Sample Site:	CN3-98	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	264
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Iron, Total	0.39	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	168	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Manganese, Dissolved	0.615	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Manganese, Total	0.623	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Potassium, Dissolved	4.2	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 20:04	
Selenium, Total	0.06	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:30	
Sodium, Dissolved	31.7	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:44	

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Lab Sample No.: 16F0483-06

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 10:50 AM
Sample Site:	CN1-58	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	265
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	28.3		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	1.2		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	29.0		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1390	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	700	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - CO2	525	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Total (as CaCO3)	574	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	14	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.2	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	0.01	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	790	10	mg/L	EPA 300.0	06/09/2016 12:30	6/9/2016 12:30	
Total Dissolved Solids (TDS)	1840	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	13	7	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Aluminum, Total	0.3	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Boron, Dissolved	0.06	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Boron, Total	0.09	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Barium, Dissolved	0.016	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Calcium, Dissolved	234	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	

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Certificate of Analysis

Lab Sample No.: 16F0483-06

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 10:50 AM
Sample Site:	CN1-58	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	265
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.05	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Iron, Total	0.36	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	195	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Manganese, Dissolved	0.193	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Manganese, Total	0.218	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Potassium, Dissolved	4.9	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 20:15	
Selenium, Total	0.07	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:41	
Sodium, Dissolved	25.5	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:48	

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Certificate of Analysis

Lab Sample No.: 16F0483-07

Name:	Alton Coal Development, LLC	***Sample Date:***	6/7/2016 11:30 AM
Sample Site:	CN1-43	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	266
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	21.8		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	-3.2		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	20.4		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	903	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	818	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - CO2	606	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Total (as CaCO3)	671	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	25	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.3	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	ND	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	370	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1150	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	32	20	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Aluminum, Total	0.09	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Boron, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Boron, Total	0.06	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Barium, Dissolved	0.023	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Calcium, Dissolved	139	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16F0483-07

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 11:30 AM
Sample Site:	CN1-43	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	266
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.52	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Iron, Total	2.61	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	135	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Manganese, Dissolved	0.220	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Manganese, Total	0.229	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Potassium, Dissolved	4.2	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 20:19	
Selenium, Total	0.05	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:45	
Sodium, Dissolved	52.0	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:52	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16F0483-08

Name:	Alton Coal Development, LLC	**Sample Date:**	6/7/2016 12:20 PM
Sample Site:	CN0-60	**Receipt Date:**	6/8/2016 2:11 PM
Comments:		**Sampler:**	Erik Petersen
Sample Matrix:	Water	**Site No.:**	267
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	
PO Number:		**Project:**	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Calculations							
Anions, Total	27.9		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cation/Anion Balance	1.8		%	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Cations, Total	28.9		meq/L	SM 1030 E	06/22/2016 07:48	6/22/2016 8:06	
Hardness, Dissolved as CaCO3	1320	1	mg/L	SM 2340 B	06/22/2016 07:48	6/22/2016 8:06	
Inorganic							
Acidity	ND	5.0	mg/L	SM 2310 B	06/10/2016 14:10	6/10/2016 14:10	
Alkalinity - Bicarbonate (HCO3)	1000	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - CO2	746	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Alkalinity - Total (as CaCO3)	823	1.0	mg/L	SM 2320 B	06/17/2016 09:03	6/17/2016 9:36	
Ammonia as N	ND	0.2	mg/L	SM 4500 NH3 H	06/10/2016 08:15	6/10/2016 8:15	
Chloride	32	1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Fluoride	0.4	0.1	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Nitrate as N	ND	0.1	mg/L	SM 4500 NO3- F	06/08/2016 18:00	6/8/2016 18:00	
Nitrite as N	ND	0.1	mg/L	SM 4500 NO2-B	06/08/2016 19:00	6/8/2016 19:00	
Phosphorus, Total as P	0.02	0.01	mg/L	SM 4500 P-E/F	06/12/2016 09:00	6/13/2016 13:30	
Sulfate	510	10	mg/L	EPA 300.0	06/09/2016 09:00	6/9/2016 9:00	
Total Dissolved Solids (TDS)	1430	20	mg/L	SM 2540 C	06/13/2016 10:54	6/13/2016 10:54	
Total Suspended Solids (TSS)	30	20	mg/L	SM 2540 D	06/09/2016 10:49	6/9/2016 10:49	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Aluminum, Total	0.2	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Arsenic, Dissolved	ND	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Arsenic, Total	ND	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Boron, Dissolved	0.11	0.05	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Boron, Total	0.13	0.05	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Barium, Dissolved	0.028	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Calcium, Dissolved	119	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Cadmium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Chromium, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Copper, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 16F0483-08

Name:	**Alton Coal Development, LLC**	***Sample Date:***	6/7/2016 12:20 PM
Sample Site:	CN0-60	***Receipt Date:***	6/8/2016 2:11 PM
Comments:		***Sampler:***	Erik Petersen
Sample Matrix:	Water	***Site No.:***	267
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	
PO Number:		***Project:***	North Lease Baseline

Parameter	Sample Result	Minimum Reporting Limit	Units	Analytical Method	Preparation Date/Time	Analysis Date/Time	Flag
Metals							
Iron, Dissolved	0.51	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Iron, Total	5.13	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Lead, Dissolved	ND	0.02	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Lead, Total	ND	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Mercury, Dissolved	ND	0.0002	mg/L	EPA 245.1	06/09/2016 12:00	6/10/2016 17:00	
Magnesium, Dissolved	249	0.2	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Manganese, Dissolved	0.106	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Manganese, Total	0.116	0.005	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Molybdenum, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Nickel, Dissolved	ND	0.005	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Potassium, Dissolved	2.8	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Selenium, Dissolved	ND	0.20	mg/L	EPA 200.7	06/13/2016 16:07	6/14/2016 20:23	
Selenium, Total	0.05	0.02	mg/L	EPA 200.7	06/13/2016 10:36	6/14/2016 19:49	
Sodium, Dissolved	54.9	0.5	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	
Zinc, Dissolved	ND	0.01	mg/L	EPA 200.7	06/13/2016 16:07	6/13/2016 21:56	

CHEMTECH - FORD ANALYTICAL LABORATORY

CHAIN OF CUSTODY

COMPANY: Alton Coal Development, LLC
ADDRESS:
CITY/STATE/ZIP: Cedar City, UT
PHONE #: FAX:
CONTACT: Kirk Nicholes PROJECT:
EMAIL: Knicholes@altoncoal.com

BILLING ADDRESS: North Lease Baseline
BILLING CITY/STATE/ZIP:
PURCHASE ORDER #:

CHEMTECH-FORD

TURNAROUND REQUIRED:*
*Expedited turnaround subject to additional charge

___ Mark 'X' here if you want a copy sent to DEQ Division of Drinking Water.

MATRIX: DW = Drinking Water; WW = Wastewater; W = Water; S = Soil; SO = Solid; SL = Sludge; O = Other

Bacteriological: R = Routine; I = Investigative; TG = Trigger Source; CO = Confirmation

REPEAT: OR = Original Location; UP = Upstream; DN = Downstream

Lab ID # F0483

Lab ID #	SAMPLE NAME	SAMPLE DATE	SAMPLE TIME	Drinking Water FACILITY ID	ANALYTICAL TESTS REQUESTED: ALTON B6W	FIELD: Residual Chlorine	Total Coliform + E. coli (Present/Absent)	Total Coliform + E. coli (Enumerated)	HPC (Plate Count)	E. coli only	WW: Total Coliform + Fecal Coliform	R/I/TG/CO	Repeat (Fail #)	SYSTEM #
-01	1. CN 2-70	6 Jun 16	20:50		X									
-02	2. CN 4-49	6 Jun 16	21:30											
-03	3. CN 7-70	6 Jun 16	22:10											
-04	4. CN 5-58	7 Jun 16	9:00											
-05	5. CN 3-98	7 Jun 16	9:40											
-06	6. CN 1-58	7 Jun 16	10:50											
-07	7. CN 1-43	7 Jun 16	11:30											
-08	8. CN0-60	7 Jun 16	12:20											
	9.													
	10.													

See Attached

Sampled by: [print] Erik Petersen

Sampled by: [signature]

ON ICE NOT ON ICE 0.0°

Special Instructions:

Relinquished by: [signature]	Date/Time	Received by: [signature]	Date/Time
	8 June 2016 13:30		8 June 2016 13:30
	8 June 2016 14:11		6/8/16 1411

CHEMTECH-FORD 6100 South Stratler Street (380 West) Murray, UT 84107 Phone: 801-262-7299 FAX: 801-262-7378 www.chemtechford.com

Payment Terms are net 30 days OAC. 1.5% interest charge per month (18% per annum). Client agress to pay collection costs and attorney's fees.

Alton Coal Development samples for 6/8/2016 drop off

Sample ID	Date	Time	Parameter list requested	DOGM site code	Billing project
SP-4	5-Jun-16	9:30	Alton Qtr GW	2	Quarterly Monitoring (North and Old)
SP-8	5-Jun-16	10:50	Alton Qtr GW	5	Quarterly Monitoring (North and Old)
LR-45	5-Jun-16	11:15	Alton Qtr GW	75	Quarterly Monitoring (North and Old)
UR-70	5-Jun-16	13:45	Alton Qtr GW	82	Quarterly Monitoring (North and Old)
Y-61	5-Jun-16	18:00	Alton Qtr GW	55	Quarterly Monitoring (North and Old)
SP-20	5-Jun-16	18:25	Alton Qtr GW	12	Quarterly Monitoring (North and Old)
SP-14	5-Jun-16	19:20	Alton Qtr GW	6	Quarterly Monitoring (North and Old)
SP-33	6-Jun-16	10:25	Alton Qtr GW	25	Quarterly Monitoring (North and Old)
LS-28	6-Jun-16	11:30	Alton Qtr GW	76	Quarterly Monitoring (North and Old)
LS-85	6-Jun-16	11:45	Alton Qtr GW	78	Quarterly Monitoring (North and Old)
SS-30	6-Jun-16	13:00	Alton Qtr GW	80	Quarterly Monitoring (North and Old)
NLP-13	6-Jun-16	16:00	Alton Qtr GW	249	Quarterly Monitoring (North and Old)
Pond Spring	6-Jun-16	18:20	Alton Qtr GW	208	Quarterly Monitoring (North and Old)
NLP-4	6-Jun-16	19:45	Alton Qtr GW	234	Quarterly Monitoring (North and Old)
NLP-5	6-Jun-16	20:20	Alton Qtr GW	235	Quarterly Monitoring (North and Old)
Y-103	7-Jun-16	10:15	Alton Qtr GW	204	Quarterly Monitoring (North and Old)
SW-2	4-Jun-16	18:00	Alton Qtr SW	29	Quarterly Monitoring (North and Old)
SW-3	4-Jun-16	19:15	Alton Qtr SW	30	Quarterly Monitoring (North and Old)
Kanab at C.R.	4-Jun-16	20:00	Alton Qtr SW	202	Quarterly Monitoring (North and Old)
SW-1M	4-Jun-16	20:45	Alton Qtr SW	268	Quarterly Monitoring (North and Old)
SW-1	4-Jun-16	21:45	Alton Qtr SW	28	Quarterly Monitoring (North and Old)
BLM-1	5-Jun-16	10:30	Alton Qtr SW	57	Quarterly Monitoring (North and Old)
SW-6	6-Jun-16	12:20	Alton Qtr SW	33	Quarterly Monitoring (North and Old)
F0483					
-01 CN2-70	6-Jun-16	20:50	Alton BGW	260	North Lease Baseline
-02 CN4-49	6-Jun-16	21:30	Alton BGW	261	North Lease Baseline
-03 CN7-70	6-Jun-16	22:10	Alton BGW	262	North Lease Baseline
-04 CN5-58	7-Jun-16	9:00	Alton BGW	263	North Lease Baseline
-05 CN3-98	7-Jun-16	9:40	Alton BGW	264	North Lease Baseline
-06 CN1-58	7-Jun-16	10:50	Alton BGW	265	North Lease Baseline
-07 CN1-43	7-Jun-16	11:30	Alton BGW	266	North Lease Baseline
-08 CN0-60	7-Jun-16	12:20	Alton BGW	267	North Lease Baseline

CHEMTECH FORD LABORATORIES
Sample Receipt

Work Order # F0483

CHEMTECH-FORD LABORATORIES

Delivery Method:

- ☐ UPS
- ☐ USPS
- ☐ FedEx
- ☐ Chemtech Courier
- ☒ Walk-in
- ☐ Customer Courier

Receiving Temperature 0.0 °C

Sample #	Container	Chemtech Lot # or Preservative	Number of Subsamples	Preserved by Client/Third Party	Preserved in Receiving/Laboratory	Filtered in Field by Client	Misc Volume (oz/mL)	Comments
-01	AQ		2					
	M	ILLEGIBLE						
	N	669						
-02-03	AQ		2					
	M	ILLEGIBLE						
	N	669						
-04	AQ		2					
	M	537						
	N	669						
-05	AQ		2					
	M	ILLEGIBLE						
	N	669						
-06	AQ		2					
	M	516						
	N	ILLEGIBLE						
-07	AQ		2					
	N	669						
	M	ILLEGIBLE						
-08	AQ		2					
	M	516						
	N	669						

Sample Condition (check if *yes*)

- ☐ Custody Seals
- ☒ Containers Intact
- ☒ COC/Labels Agree
- ☒ Preservation Confirmed
- ☒ Received on Ice
- ☒ Correct Containers(s)
- ☒ Sufficent Sample Volume
- ☐ Headspace Present (VOC)
- ☐ Temperature Blank
- ☒ Received within Holding Time

Plastic Containers

A- Plastic Unpreserved
B- Miscellaneous Plastic
C- Cyanide Qt (NaOH)
E- Coliform/Ecoli/HPC
F- Sulfide Qt (Zn Acetate)
L- Mercury 1631
M- Metals Pint (HNO3)
N- Nutrient Pint (H2SO4)
R- Radiological (HNO3)
S- Sludge Cups/Tubs
Q- Plastic Bag

Glass Containers

D- 625 (Na2S2O3)
G- Glass Unpreserved
H- HAAs (NH4Cl)
J- 508/515/525 (Na2SO3)
K- 515.3 Herbicides
O- Oil & Grease (HCl)
P- Phenols (H2SO4)
T- TOC/TOX (H3PO4)
U- 531 (MCAA, Na2S2O3)
V- 524/THMs (Ascorbic Acid)
W- 8260 VOC (1:1 HCl)
X- Vial Unpreserved
Y- 624/504 (Na2S2O3)
Z- Miscellaneous Glass

Report Footnotes

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

Additional Report Information

The analyses presented on this report were performed in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted in the comments, flags or case narrative. If the report is to be used for regulatory compliance, it should be presented in its entirety, and not be altered.

Chemtech-Ford Contact Information

Labortory Director	Dave Gayer	dgayer@chemtechford.com	801.262.7299 (Main)	801.639.1172 (Direct)
QA Officer	Ron Fuller	rfuller@chemtechford.com	801.262.7299 (Main)	801.693.1171 (Direct)

Attachment F

THWELLS Modeling data

```
↑
********************** THWELLS - version 4.01 **********************  PAGE 1

CALCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC, CONFINED, LEAKY
CONFINED OR UNCONFINED AQUIFER WITH MULTIPLE PRODUCTION AND INJECTION
WELLS AND UNIFORM REGIONAL FLOW

--------------------------------------------------------------------------------
TRUE
--------------------------------------------------------------------------------


********************************* INPUT DATA *********************************

              LEAKY CONFINED AQUIFER - HANTUSH-JACOB'S EQUATION

                                       TRANSMISSIVITY  =  4990 [gpd/ft]

                                  STORAGE COEFFICIENT  =  .0001599

                               REGIONAL FLOW GRADIENT
         (positive--downwards--in flow direction)  =  .004

                              REGIONAL FLOW DIRECTION
                         (horizontal angle in degrees
          counter-clockwise from positive x-axis)  =  22.5

                        REGIONAL FLOW OFFSET AT ORIGIN
                   (positive in downwards direction)  =  0 [ft]

        HYDRAULIC CONDUCTIVITY OF CONFINING LAYER =  .0831 [gpd/sq.ft]

                         THICKNESS OF CONFINING LAYER  =  20 [ft]

--------------------------------------------------------------------------------

↑
*********************************************************** THWELLS - PAGE 2


                         PUMPING/INJECTION WELL DATA


     WELL NO. 1

                                      X-COORDINATE  =  0 [ft]
                                      Y-COORDINATE  =  500 [ft]
```

```
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


  WELL NO. 2

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  400 [ft]
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


  WELL NO. 3

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  300 [ft]
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


  WELL NO. 4

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  200 [ft]
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


  WELL NO. 5

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  100 [ft]
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


  WELL NO. 6

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  0 [ft]
               PUMPING/INJECTION RATE  =  43200 [gpd]
   TIME SINCE START PUMPING/INJECTION  =  10 [day]


--------------------------------------------------------------------------------

************************************************************ THWELLS - PAGE 3
```

```
WELL NO. 7

                          X-COORDINATE  =  0 [ft]
                          Y-COORDINATE  = -100 [ft]
                PUMPING/INJECTION RATE  =  43200 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 8

                          X-COORDINATE  =  0 [ft]
                          Y-COORDINATE  = -200 [ft]
                PUMPING/INJECTION RATE  =  43200 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 9

                          X-COORDINATE  =  0 [ft]
                          Y-COORDINATE  = -300 [ft]
                PUMPING/INJECTION RATE  =  43200 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 10

                          X-COORDINATE  =  0 [ft]
                          Y-COORDINATE  = -400 [ft]
                PUMPING/INJECTION RATE  =  43200 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 11

                          X-COORDINATE  =  0 [ft]
                          Y-COORDINATE  = -500 [ft]
                PUMPING/INJECTION RATE  =  43200 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]

--------------------------------------------------------------------------------
↑
********************************* RESULTS ******************* THWELLS - PAGE 4


------------------------------- Drawdown in [ft] -------------------------------
```

Y [ft]	-1000	-900	-800	-700	-600	-500
-1000.00	2.182	2.966	3.776	4.607	5.450	6.294
-900.00	2.379	3.225	4.108	5.024	5.966	6.924
-800.00	2.577	3.490	4.452	5.465	6.523	7.618
-700.00	2.770	3.751	4.799	5.915	7.103	8.360
-600.00	2.946	3.997	5.131	6.356	7.682	9.117
-500.00	3.096	4.213	5.430	6.762	8.226	9.841
-400.00	3.208	4.386	5.680	7.109	8.699	10.481
-300.00	3.274	4.502	5.860	7.372	9.069	10.989
-200.00	3.284	4.550	5.956	7.531	9.307	11.328
-100.00	3.231	4.521	5.958	7.571	9.396	11.478
0.00	3.112	4.410	5.857	7.483	9.325	11.427
100.00	2.925	4.215	5.652	7.265	9.090	11.172
200.00	2.671	3.938	5.344	6.919	8.695	10.716
300.00	2.355	3.583	4.941	6.454	8.150	10.070
400.00	1.984	3.161	4.455	5.885	7.475	9.256
500.00	1.565	2.682	3.900	5.232	6.695	8.310
600.00	1.109	2.160	3.294	4.519	5.845	7.280
700.00	0.627	1.608	2.656	3.772	4.960	6.217
800.00	0.128	1.041	2.003	3.015	4.074	5.169
900.00	-0.377	0.470	1.352	2.268	3.211	4.168

<- X [ft] ->

Y [ft]	-400	-300	-200	-100	0	100
-1000.00	7.120	7.901	8.605	9.196	9.643	9.935
-900.00	7.875	8.790	9.619	10.304	10.787	11.044
-800.00	8.733	9.832	10.853	11.698	12.247	12.437
-700.00	9.676	11.025	12.344	13.489	14.182	14.228
-600.00	10.666	12.328	14.083	15.830	16.990	16.569
-500.00	11.633	13.635	15.902	18.572	27.600	19.311
-400.00	12.495	14.801	17.497	20.764	30.257	21.503
-300.00	13.182	15.718	18.695	22.251	31.886	22.990
-200.00	13.648	16.336	19.479	23.178	32.872	23.917
-100.00	13.872	16.645	19.874	23.641	33.361	24.380
0.00	13.846	16.646	19.901	23.688	33.416	24.427
100.00	13.566	16.339	19.568	23.335	33.055	24.074
200.00	13.036	15.724	18.867	22.566	32.260	23.305
300.00	12.263	14.799	17.776	21.333	30.967	22.072
400.00	11.271	13.577	16.272	19.540	29.033	20.279
500.00	10.102	12.104	14.372	17.041	26.069	17.781
600.00	8.829	10.492	12.246	13.993	15.154	14.733
700.00	7.533	8.882	10.201	11.346	12.039	12.085
800.00	6.284	7.383	8.404	9.249	9.797	9.988

<- X [ft] ->

Y [ft] <- X [ft] ->

Y [ft]	-400	-300	-200	-100	0	100
900.00	5.120	6.034	6.864	7.549	8.032	8.288

Y [ft] <- X [ft] ->

Y [ft]	200	300	400	500	600	700
-1000.00	10.083	10.118	10.076	9.990	9.885	9.781
-900.00	11.098	11.007	10.832	10.619	10.401	10.197
-800.00	12.331	12.049	11.689	11.314	10.957	10.638
-700.00	13.823	13.243	12.633	12.056	11.538	11.089
-600.00	15.561	14.546	13.622	12.812	12.116	11.530
-500.00	17.381	15.852	14.589	13.537	12.661	11.936
-400.00	18.975	17.019	15.452	14.177	13.134	12.283
-300.00	20.173	17.935	16.138	14.684	13.504	12.546
-200.00	20.957	18.554	16.605	15.024	13.742	12.705
-100.00	21.352	18.863	16.829	15.174	13.831	12.745
0.00	21.379	18.863	16.802	15.123	13.759	12.657
100.00	21.046	18.556	16.523	14.867	13.524	12.438
200.00	20.345	17.941	15.992	14.411	13.130	12.092
300.00	19.255	17.017	15.220	13.766	12.585	11.627
400.00	17.750	15.794	14.227	12.952	11.910	11.058
500.00	15.850	14.322	13.059	12.006	11.130	10.405
600.00	13.725	12.709	11.785	10.975	10.280	9.693
700.00	11.680	11.100	10.490	9.913	9.395	8.946
800.00	9.882	9.600	9.240	8.865	8.508	8.189
900.00	8.342	8.252	8.077	7.864	7.646	7.442

Y [ft] <- X [ft] ->

Y [ft]	800	900
-1000.00	9.689	9.618
-900.00	10.021	9.877
-800.00	10.365	10.142
-700.00	10.711	10.403
-600.00	11.043	10.649
-500.00	11.343	10.865
-400.00	11.592	11.038
-300.00	11.773	11.154
-200.00	11.869	11.202
-100.00	11.871	11.173

```
     0.00       11.770     11.062
   100.00       11.565     10.867
   200.00       11.257     10.589
   300.00       10.854     10.235
   400.00       10.368      9.813
   500.00        9.813      9.334
   600.00        9.206      8.812
   700.00        8.568      8.260
   800.00        7.916      7.693

*********************** THWELLS - version 4.01 ***********************  PAGE 6


  Y [ft]                          <- X [ft] ->
--------------------------------------------------------------------------------
              800         900
   900.00        7.265      7.122

--------------------------------------------------------------------------------
```

```
↑
********************** THWELLS - version 4.01 **********************  PAGE 1

CALCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC, CONFINED, LEAKY
CONFINED OR UNCONFINED AQUIFER WITH MULTIPLE PRODUCTION AND INJECTION
WELLS AND UNIFORM REGIONAL FLOW

--------------------------------------------------------------------------------
Scenario 2
--------------------------------------------------------------------------------


********************************* INPUT DATA *********************************

              LEAKY CONFINED AQUIFER - HANTUSH-JACOB'S EQUATION

                                  TRANSMISSIVITY  =  4990 [gpd/ft]

                             STORAGE COEFFICIENT  =  .0001599

                          REGIONAL FLOW GRADIENT
        (positive--downwards--in flow direction)  =  .004

                         REGIONAL FLOW DIRECTION
                       (horizontal angle in degrees
         counter-clockwise from positive x-axis)  =  22.5

                  REGIONAL FLOW OFFSET AT ORIGIN
             (positive in downwards direction)  =  0 [ft]

        HYDRAULIC CONDUCTIVITY OF CONFINING LAYER =  .0831 [gpd/sq.ft]

                    THICKNESS OF CONFINING LAYER  =  20 [ft]

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↑
*********************************************************** THWELLS - PAGE 2


                         PUMPING/INJECTION WELL DATA


     WELL NO. 1

                             X-COORDINATE  =  0 [ft]
                             Y-COORDINATE  =  500 [ft]
```

```
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 2

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  400 [ft]
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 3

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  300 [ft]
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 4

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  200 [ft]
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 5

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  100 [ft]
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 6

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  0 [ft]
               PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]

--------------------------------------------------------------------------------

************************************************************ THWELLS - PAGE 3
```

```
WELL NO. 7

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -100 [ft]
              PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 8

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -200 [ft]
              PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 9

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -300 [ft]
              PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 10

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -400 [ft]
              PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 11

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -500 [ft]
              PUMPING/INJECTION RATE  =  72000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]

--------------------------------------------------------------------------------

******************************** RESULTS ****************** THWELLS - PAGE 4


------------------------------- Drawdown in [ft] -------------------------------
```

Y [ft] <- X [ft] ->

Y [ft]	-1000	-900	-800	-700	-600	-500
-1000.00	5.079	6.141	7.244	8.382	9.542	10.701
-900.00	5.510	6.674	7.899	9.179	10.504	11.853
-800.00	5.943	7.218	8.575	10.016	11.533	13.113
-700.00	6.365	7.755	9.254	10.869	12.603	14.451
-600.00	6.761	8.266	9.910	11.705	13.669	15.814
-500.00	7.113	8.729	10.511	12.485	14.678	17.123
-400.00	7.403	9.119	11.029	13.165	15.569	18.292
-300.00	7.614	9.414	11.431	13.705	16.287	19.240
-200.00	7.732	9.596	11.694	14.072	16.786	19.908
-100.00	7.747	9.650	11.799	14.241	17.036	20.260
0.00	7.650	9.567	11.733	14.196	17.019	20.277
100.00	7.441	9.344	11.492	13.934	16.730	19.954
200.00	7.120	8.984	11.082	13.460	16.174	19.296
300.00	6.696	8.496	10.513	12.787	15.368	18.321
400.00	6.178	7.894	9.804	11.941	14.345	17.067
500.00	5.582	7.198	8.981	10.954	13.147	15.593
600.00	4.924	6.430	8.073	9.868	11.832	13.977
700.00	4.222	5.612	7.111	8.726	10.459	12.308
800.00	3.494	4.768	6.126	7.567	9.084	10.664
900.00	2.754	3.919	5.143	6.424	7.748	9.098

Y [ft] <- X [ft] ->

Y [ft]	-400	-300	-200	-100	0	100
-1000.00	11.831	12.887	13.814	14.553	15.052	15.292
-900.00	13.193	14.470	15.607	16.502	17.061	17.241
-800.00	14.724	16.309	17.765	18.927	19.595	19.666
-700.00	16.399	18.400	20.352	22.013	22.923	22.752
-600.00	18.150	20.674	23.353	26.018	27.705	26.757
-500.00	19.864	22.954	26.486	30.690	45.490	31.429
-400.00	21.403	25.000	29.246	34.445	50.021	35.184
-300.00	22.649	26.629	31.345	37.026	52.837	37.765
-200.00	23.528	27.762	32.753	38.673	54.583	39.412
-100.00	24.004	28.379	33.513	39.546	55.500	40.285
0.00	24.062	28.482	33.661	39.727	55.694	40.466
100.00	23.698	28.073	33.207	39.240	55.194	39.979
200.00	22.916	27.150	32.141	38.060	53.970	38.800
300.00	21.731	25.711	30.426	36.107	51.918	36.846
400.00	20.178	23.775	28.021	33.221	48.796	33.960
500.00	18.333	21.423	24.956	29.159	43.959	29.898
600.00	16.313	18.837	21.516	24.181	25.868	24.920
700.00	14.256	16.257	18.209	19.870	20.780	20.609
800.00	12.275	13.860	15.316	16.478	17.145	17.217

Y [ft]	-400	-300	-200	-100	0	100
900.00	10.438	11.715	12.851	13.747	14.305	14.486

Y [ft]	200	300	400	500	600	700
-1000.00	15.292	15.104	14.787	14.397	13.976	13.556
-900.00	17.085	16.688	16.149	15.548	14.938	14.353
-800.00	19.243	18.526	17.680	16.808	15.968	15.190
-700.00	21.831	20.618	19.355	18.147	17.037	16.043
-600.00	24.831	22.892	21.106	19.509	18.104	16.879
-500.00	27.965	25.171	22.820	20.819	19.112	17.659
-400.00	30.724	27.217	24.359	21.988	20.004	18.339
-300.00	32.823	28.847	25.605	22.935	20.722	18.879
-200.00	34.232	29.979	26.485	23.604	21.221	19.246
-100.00	34.992	30.596	26.960	23.955	21.471	19.414
0.00	35.139	30.699	27.018	23.972	21.454	19.370
100.00	34.686	30.290	26.654	23.649	21.165	19.108
200.00	33.619	29.367	25.872	22.991	20.608	18.633
300.00	31.904	27.928	24.687	22.017	19.803	17.961
400.00	29.499	25.993	23.134	20.763	18.779	17.114
500.00	26.434	23.641	21.289	19.288	17.582	16.128
600.00	22.994	21.055	19.269	17.673	16.267	15.042
700.00	19.688	18.475	17.212	16.004	14.894	13.900
800.00	16.794	16.077	15.231	14.359	13.519	12.740
900.00	14.330	13.932	13.394	12.793	12.183	11.597

Y [ft]	800	900
-1000.00	13.157	12.793
-900.00	13.811	13.326
-800.00	14.488	13.869
-700.00	15.167	14.407
-600.00	15.822	14.918
-500.00	16.424	15.381
-400.00	16.941	15.771
-300.00	17.344	16.066
-200.00	17.607	16.248
-100.00	17.711	16.302

0.00	17.645	16.219
100.00	17.405	15.996
200.00	16.995	15.636
300.00	16.426	15.148
400.00	15.717	14.546
500.00	14.894	13.850
600.00	13.985	13.082
700.00	13.024	12.264
800.00	12.039	11.420

```
********************** THWELLS - version 4.01 **********************  PAGE 6


  Y [ft]                           <- X [ft] ->
--------------------------------------------------------------------------------
             800         900
   900.00      11.056     10.570

--------------------------------------------------------------------------------
```

↑
```
********************** THWELLS - version 4.01 **********************  PAGE 1

CALCULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC, CONFINED, LEAKY
CONFINED OR UNCONFINED AQUIFER WITH MULTIPLE PRODUCTION AND INJECTION
WELLS AND UNIFORM REGIONAL FLOW

--------------------------------------------------------------------------------
Scenario 2
--------------------------------------------------------------------------------


********************************* INPUT DATA *********************************

              LEAKY CONFINED AQUIFER - HANTUSH-JACOB'S EQUATION

                                  TRANSMISSIVITY  =  4990 [gpd/ft]

                             STORAGE COEFFICIENT  =  .0001599

                          REGIONAL FLOW GRADIENT
        (positive--downwards--in flow direction)  =  .004

                         REGIONAL FLOW DIRECTION
                   (horizontal angle in degrees
         counter-clockwise from positive x-axis)  =  22.5

                  REGIONAL FLOW OFFSET AT ORIGIN
             (positive in downwards direction)  =  0 [ft]

        HYDRAULIC CONDUCTIVITY OF CONFINING LAYER =  .0831 [gpd/sq.ft]

                     THICKNESS OF CONFINING LAYER  =  20 [ft]

--------------------------------------------------------------------------------
```

↑
```
*********************************************************** THWELLS - PAGE 2


                         PUMPING/INJECTION WELL DATA


     WELL NO. 1

                             X-COORDINATE  =  0 [ft]
                             Y-COORDINATE  =  500 [ft]
```

```
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


 WELL NO. 2

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  400 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


 WELL NO. 3

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  300 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


 WELL NO. 4

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  200 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


 WELL NO. 5

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  100 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


 WELL NO. 6

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  0 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


--------------------------------------------------------------------------------

************************************************************ THWELLS - PAGE 3
```

```
WELL NO. 7

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -100 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 8

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -200 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 9

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -300 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 10

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -400 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]


WELL NO. 11

                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  = -500 [ft]
              PUMPING/INJECTION RATE  =  108000 [gpd]
  TIME SINCE START PUMPING/INJECTION  =  10 [day]

--------------------------------------------------------------------------------
↑
********************************* RESULTS ******************* THWELLS - PAGE 4


------------------------------- Drawdown in [ft] -------------------------------
```

Y [ft]	<- X [ft] -> -1000	-900	-800	-700	-600	-500
-1000.00	8.701	10.109	11.579	13.102	14.656	16.211
-900.00	9.423	10.985	12.637	14.373	16.175	18.014
-800.00	10.150	11.877	13.729	15.705	17.796	19.981
-700.00	10.860	12.760	14.824	17.061	19.477	22.065
-600.00	11.530	13.603	15.883	18.392	21.153	24.186
-500.00	12.135	14.374	16.863	19.638	22.743	26.226
-400.00	12.646	15.035	17.715	20.735	24.156	28.056
-300.00	13.039	15.555	18.396	21.622	25.309	29.554
-200.00	13.293	15.904	18.867	22.248	26.135	30.633
-100.00	13.391	16.062	19.100	22.578	26.586	31.237
0.00	13.323	16.014	19.077	22.588	26.637	31.339
100.00	13.085	15.756	18.793	22.272	26.280	30.931
200.00	12.681	15.292	18.254	21.636	25.523	30.021
300.00	12.121	14.636	17.477	20.703	24.391	28.636
400.00	11.421	13.810	16.490	19.510	22.932	26.831
500.00	10.604	12.843	15.332	18.108	21.212	24.696
600.00	9.694	11.767	14.046	16.555	19.316	22.349
700.00	8.717	10.617	12.681	14.918	17.334	19.922
800.00	7.701	9.428	11.280	13.256	15.347	17.532
900.00	6.668	8.230	9.882	11.618	13.420	15.259

Y [ft]	<- X [ft] -> -400	-300	-200	-100	0	100
-1000.00	17.720	19.119	20.326	21.249	21.813	21.988
-900.00	19.840	21.571	23.091	24.249	24.902	24.988
-800.00	22.213	24.405	26.405	27.963	28.780	28.702
-700.00	24.801	27.619	30.362	32.669	33.848	33.408
-600.00	27.505	31.107	34.939	38.752	41.099	39.492
-500.00	30.152	34.603	39.717	45.837	67.852	46.576
-400.00	32.537	37.748	43.932	51.547	74.725	52.286
-300.00	34.483	40.269	47.157	55.494	79.026	56.233
-200.00	35.878	42.045	49.346	58.041	81.721	58.780
-100.00	36.668	43.047	50.563	59.427	83.174	60.166
0.00	36.831	43.277	50.860	59.775	83.540	60.514
100.00	36.362	42.740	50.257	59.121	82.867	59.860
200.00	35.266	41.432	48.734	57.428	81.109	58.168
300.00	33.565	39.350	46.238	54.575	78.107	55.314
400.00	31.312	36.523	42.707	50.322	73.500	51.061
500.00	28.621	33.072	38.186	44.306	66.322	45.045
600.00	25.668	29.270	33.102	36.916	39.262	37.655
700.00	22.658	25.476	28.219	30.526	31.705	31.265
800.00	19.764	21.956	23.956	25.514	26.331	26.253

********************** THWELLS - version 4.01 ********************** PAGE 5

Y [ft]	-400	-300	-200	-100	0	100
900.00	17.084	18.816	20.335	21.494	22.147	22.233

Y [ft]	200	300	400	500	600	700
-1000.00	21.804	21.336	20.676	19.906	19.091	18.276
-900.00	24.569	23.788	22.796	21.710	20.610	19.547
-800.00	27.883	26.623	25.169	23.676	22.231	20.879
-700.00	31.841	29.836	27.758	25.761	23.911	22.235
-600.00	36.417	33.324	30.461	27.881	25.587	23.566
-500.00	41.195	36.820	33.108	29.922	27.177	24.812
-400.00	45.410	39.965	35.493	31.751	28.591	25.909
-300.00	48.635	42.486	37.439	33.250	29.744	26.796
-200.00	50.825	44.262	38.835	34.328	30.569	27.422
-100.00	52.041	45.264	39.625	34.933	31.021	27.751
0.00	52.339	45.495	39.788	35.035	31.072	27.762
100.00	51.735	44.958	39.319	34.627	30.715	27.445
200.00	50.212	43.650	38.223	33.716	29.957	26.810
300.00	47.716	41.568	36.521	32.331	28.826	25.877
400.00	44.186	38.741	34.269	30.527	27.366	24.684
500.00	39.664	35.289	31.577	28.391	25.647	23.281
600.00	34.580	31.487	28.624	26.044	23.751	21.729
700.00	29.697	27.693	25.615	23.618	21.768	20.092
800.00	25.434	24.174	22.720	21.227	19.782	18.429
900.00	21.814	21.033	20.041	18.954	17.855	16.791

Y [ft]	800	900
-1000.00	17.492	16.761
-900.00	18.550	17.637
-800.00	19.642	18.529
-700.00	20.737	19.412
-600.00	21.796	20.255
-500.00	22.775	21.025
-400.00	23.628	21.687
-300.00	24.308	22.207
-200.00	24.779	22.556
-100.00	25.012	22.714

0.00	24.990	22.666
100.00	24.706	22.407
200.00	24.167	21.944
300.00	23.390	21.288
400.00	22.403	20.462
500.00	21.245	19.495
600.00	19.959	18.419
700.00	18.594	17.269
800.00	17.193	16.080

Y [ft]	<- X [ft] ->	
	800	900
900.00	15.795	14.882