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DEPARTMENT OF NATURAL RESOURCES

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September 22, 2014

Kirk Nicholes, Resident Agent
Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720

Subject: Alluvial Valley Floor Report Review, Alton Coal Development, LLC, Coal Hollow Mine, C0250005, Task ID #4641

Dear Mr. Nicholes:

The Division has completed a review of the Alluvial Valley Floor Report on the North Private Lease area, received on July 17, 2014. Pursuant to R645-302-321.100 the Division has evaluated the report and investigated the existence of a probable alluvial valley floor.

The results of our review are discussed in the enclosed Technical Memorandum. You will note in the summary that there are a few areas that require additional information. Please provide the information requested at your earliest convenience so that the final determination can be made.

Thank you for your efforts during the permitting process.

Sincerely,

Daron R. Haddock
Coal Program Manager

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TECHNICAL MEMORANDUM

Utah Coal Regulatory Program

September 16, 2014

TO: Internal File

THRU: Priscilla Burton, Team Lead

FROM: Daron Haddock, Joe Henrich, Priscilla Burton, Steve Christensen, Amanda Daniels, Keenan Storrar, Environmental Scientists

RE: Alluvial Valley Floor Report, Alton Coal Development, LLC, Coal Hollow, C0250005, Task ID #4641

SUMMARY:

On July 17th, 2014, the Division of Oil, Gas and Mining (the Division) received an alluvial valley floor (AVF) investigation report from Alton Coal Development, LLC (the Permittee).

Per the requirements of R645-302-320, the Permittee submitted the results of an AVF field investigation report (the report) for potential mining activity in a private lease area north of the current permit area (North Private Lease). As required by R645-302-321.100, the Division must make an evaluation regarding the existence of the probable AVF in the proposed permit or adjacent area and determine which areas, if any, require more detailed study in order to allow the Division to make a final determination regarding the existence of an AVF.

The field investigation (as outlined in R645-302-321.210) must include:

- 1) Mapping of unconsolidated stream-laid deposits holding streams, including, but not limited to, geologic maps of unconsolidated deposits and stream-laid deposits, maps of streams, delineation of surface watersheds and directions of shallow groundwater flows through and into the unconsolidated deposits, topography showing local and regional terrace levels and topography of terraces, flood plains and channels showing surface drainage patterns;
- 2) Mapping of lands included in the area subject to agricultural activities, showing the area in which different types of agricultural lands, such as flood irrigated lands, pasture lands and undeveloped rangelands, exist, and accompanied by measurements of vegetation in terms of productivity and type;

- 3) Mapping of all lands that are currently or were historically flood irrigated, showing the location of each diversion structure, ditch, dam and related reservoir, irrigated land, and topography of those lands;
- 4) Documentation that areas identified are, or are not, sub-irrigated, based on groundwater monitoring data, representative water quality, soil moisture measurements and measurements of rooting depth, soil mottling, and water requirements of vegetation;
- 5) Documentation, based on representative sampling, that areas are, or are not, flood irrigable, based on streamflow, water quality, water yield, soils measurements and topographic characteristics and
- 6) Analyses of a series of aerial photographs, including color infrared imagery flown at a time of year to show any late summer and fall differences between upland and valley floor vegetative growth and of a scale adequate for reconnaissance identification of areas that may be alluvial valley floors.

Upon review of the Alluvial Valley Floor Field Investigation provided by the Permittee of the North Private Lease, the Division is requesting additional information. Please provide clarification and/or additional data to address the following:

R645-302-321.322- Based on Hydrology Map 7, irrigation water is allocated to some lands just south of the farm road, and north of the elk fence. Currently, there are fields in this area that are irrigated using hand lines as outlined in Soils Map 5. Please provide further information that would demonstrate why these lands (currently irrigated lands south of the farm road and north of the elk fence) do not have the capability of being flood irrigated.

R645-302-321.200- The high and low water depths, as labeled on Hydrology Map 3 do not correspond with depths measured with the piezometers in Table B-2a, please address this discrepancy.

R645-302-321.200- Water data is provided for NLP-13 in Tables B-2a and B-2b, but this well doesn't appear on Figure 2 of page 22 of the report, Hydrology Map 3, or in Tables B-1 and B-3. Please correct this discrepancy or provide explanation as to why this well has been excluded.

R645-302-321.260- Page 9 paragraph 5, the pastures within and adjacent to Kanab creek in the lease appear to be used for grazing at least from the 9/3/2014 site visit. The text in this paragraph should be clarified based on the 9/3/2014 site visit and personal communication with the landowner or individuals responsible for grazing in the area.

Page 9 paragraph 5, 2nd italicized paragraph, it appears as though this excerpt from the OSM guidelines (1983) was included in the application under the assumption that there was a "consensus". The applicant needs to clarify this statement by providing documentation that supports this assumption.

Some of the land just south of the farm road is not capable of flood irrigation, mainly due to topography, but small portions of it appear to be capable of flood irrigated through the existing irrigation company's diversion system. The Permittee must provide additional information as to why they have excluded these areas as potential AVF.

Additional information will need to be submitted during any permitting action which would characterize the coal seam and the relative depths of coal and overburden. A Geologic cross section through the valley is needed.

TECHNICAL ANALYSIS:

GENERAL CONTENTS

PERMIT APPLICATION FORMAT AND CONTENTS

Regulatory Reference: 30 CFR 777.11; R645-301-120.

Analysis:

The following errors were noted in the application;
Page 8, Paragraph 1, line 2, add the word *of* after one;
Page 16, Paragraph 3, line 3, move the word *are* in front of located and;
Page 20, Paragraph 1, line 3, delete the bold typed words.

Findings:

The information is not adequate to meet the requirements of this section of the regulations. Prior to approval the following information is required in accordance with **R645-301-120**;
The following errors were noted in the application;
Page 8, Paragraph 1, line 2, add the word *of* after one;
Page 16, Paragraph 3, line 3, move the word *are* in front of located and;
Page 20, Paragraph 1, line 3, delete the bold typed words.

ENVIRONMENTAL RESOURCE INFORMATION

Regulatory Reference: Pub. L 95-87 Sections 507(b), 508(a), and 516(b); 30 CFR 783., et. al.

ALLUVIAL VALLEY FLOORS

Regulatory Reference: 30 CFR 785.19; 30 CFR 822; R645-302-320.

Analysis:

Alluvial Valley Floor Determination

The North Lease parcel of approximately 393 acres is located ½ mile south east of the town of Alton, Utah. The vegetation in the study area of the North Private Lease is shown on Vegetation map 1 in Appendix J of the application. The vegetative communities identified

include Pastureland, Cropland, Wetlands and a small amount of Pinyon Juniper Sagebrush. Map #2 (Sample Locations) identifies the 21 locations of the vegetation transects where the vegetative data was collected. Maps 3 through 6 are a series of color infrared imagery taken in June 2011, August 2009, August 2006 and November 2007.

Page 9 paragraph 5, the pastures within and adjacent to Kanab creek in the lease appear to be used for grazing at least from the 9/3/2014 site visit. The text in this paragraph should be clarified based on personal communication with the landowner or individuals responsible for grazing in the area.

Page 9 paragraph 5, 2nd italicized paragraph, it appears as though this excerpt from the OSM guidelines (1983) was included in the application under the assumption that there was a "consensus". The applicant needs to clarify this statement. The information on page 11 regarding Agriculture is more appropriately stated.

In accordance with R645-302-321.260 the applicant has provided the analyses of a series of color infrared aerial photographs taken in taken in June 2011, August 2009, August 2006 and November 2007. In terms of accuracy the regulations seem to imply that the seasonal variations (late summer & fall) CIR photos are taken during the same calendar or water year. A comparison of these photos (map 6 Nov to maps 4 and 5 Aug) seems to indicate that water is being provided to the vegetation north of the Farm road from either man caused or sub irrigation indicating that this area as delineated on the "Probable Alluvial Valley Floor Area" map is a potential AVF.

However the sub irrigated portions of Kanab creek and the intermittent ground water drain (as shown on soils map 6) are showing very slight if any indications of vegetation receiving water (on vegetation map 6) indicating that the vegetation may have died off and or was no longer transpiring at the time the photo was taken. The vegetation and soils survey data coupled with the September 3rd site visit do support the conclusion that sub irrigation below the farm road is limited to these two incised channels.

Wetlands

There are about 9 acres of wetlands in the study area located on Vegetation map 1. These areas (which are basically the sub irrigated channels) meet the criteria for delineated wetlands (soils, hydrology, vegetation) as defined by the Army Corps of Engineers. The vegetation of these wetlands includes; beaded sedge, small wing sedge, bluegrass, woody sedge, Douglas sedge, maritime arrowgrass, common threesquare, longstyle rush, Missouri iris, willows, wire grass, Wood's rose and Russian olive. Transects were completed at sample sites V02, 04, 06, 08, 09 and V10 as shown on vegetation map 2.

Findings:

The information is not adequate to meet the requirements of this section of the regulations. Prior to approval the following information is required in accordance with **R645-302-321.260**;

Page 9 paragraph 5, the pastures within and adjacent to Kanab creek in the lease appear to be used for grazing at least from the 9/3/2014 site visit. The text in this paragraph should be clarified based on the 9/3/2014 site visit and personal communication with the landowner or individuals responsible for grazing in the area.

Page 9 paragraph 5, 2nd italicized paragraph, it appears as though this excerpt from the OSM guidelines (1983) was included in the application under the assumption that there was a "consensus". The applicant needs to clarify this statement by providing documentation that supports this assumption.

The information on page 11 regarding Agriculture is more appropriately stated. There are several editing and one clarification deficiencies that need to be addressed prior to final approval. However, based on the information provided in this document it is recommended that the Division concur with the applicant's AVF determination for the Private North Lease Parcel.

MAPPING OF AGRICULTURAL LANDS

The elevation is 6,980 ft to 6,848 ft. The topography is gradually sloping. AVF Summary page 15 - 18 describes the study area, as:

- 306 acres of pasturelands (grasses), including flood plains and stream terraces
- 87 acres croplands (alfalfa, wheat, and silage)
- 25 acres of undisturbed rangelands
- 9 acres of wetlands in channels and drainages and uplands in

The above areas are illustrated on Vegetation Map 1. It must be noted that the definition of croplands in the R645 Rules includes pastures of hay and alfalfa as follows:

"Cropland" means land used for the production of adapted crops for harvest, alone or in a rotation with grasses and legumes, and includes row crops, small grain crops, hay crops, nursery crops, orchard crops, and other similar specialty crops"

Irrigated croplands are in T39S, R6W, Section 12 and T39S, R5W, Section 7 north of the farm road (Map 1 and Soils Map 5). Irrigated pasturelands of alfalfa/grass are found south of the farm road (Soils Map 9). Irrigation water is delivered from reservoirs and diversions outside the fee lease area, along upper Kanab Creek (Hydrographic Maps 1A through F). Soil Map 2 also shows a pond within the fee lease boundary for irrigation.

Productivity of the cropland north of the farm road is about 4 tons/acre (site V-11). Productivity of between 500 to 1200 lbs/acre were noted for pastureland south of the farm road (Sites V-12 to V-20, AVF Summary Vegetation Table 4). The value of supreme to premium dairy quality alfalfa hay would be on the order of \$200 to 250/Ton, based upon the Utah Department of Agriculture's September 12, 2014 Market Report for Southern Utah good feeder to dairy quality hay (http://www.ams.usda.gov/mnreports/ag_gr310.txt). This figure would not include the value of after crop grazing.

MAPPING OF CURRENT OF HISTORIC FLOOD IRRIGATED LANDS

There are no flood irrigated lands in the proposed north fee lease area (AVF Summary. p 19).

DOCUMENTATION OF SUBIRRIGATION

Rooting depths (0.7 feet to 5.7 feet deep) do not enter the ground water that is 5 to greater than 23 feet deep, as illustrated on Hydrology Map 3. Subirrigation was found only along the immediate riparian corridor of Kanab Creek (Soils Map 6), corresponding to the 9 acres of wetlands above.

DOCUMENTATION OF WATER QUALITY AND YIELD, STREAM FLOW, SOIL CHARACTERISTICS, AND TOPOGRAPHY AFFECTING FLOOD IRRIGATION POTENTIAL

SOIL CHARACERISTICS

Appendices D (Soil Survey Methods), E (Prime Farmland determination), I (Soil Maps), K (Lab Analysis) and L(Soil Descriptions with photos) contain soil survey information of 69 sample locations. The soil survey information is briefly summarized in Section 321.220 at the AVF Summary Tab.

An Order II Soil Survey of 428 acres was conducted by Robert Long. Soil Map 1 shows the location of the 69 sampling locations. Soil profiles were sampled by horizon and analyzed by Intermountain Laboratory/Sheridan. The lab analysis parameters are summarized in Soils Table 1 of Appendix D. Table 2 App. D provides the taxonomic classification of the fifteen soil families found. Physiographic settings, slope and soil type further distinguished twelve soil map units (Table 3 App. D and Map 2). Deposition of alluvium and slope-wash are the predominant parent materials (Soils Map 3). Calcium carbonate contents greater than 30% and up to 76% were noted in soils that developed from limestone on terrace remnants (Soil Map 4). Soils Table 4 lists the soils with carbonate contents over 30% that are rated as poor quality for reclamation as described in the Division's Guidelines for Soils and Overburden. These soils are found in every map unit listed in Table 3 App. D. In the surface four feet, sodicity is not an issue at this site.

Low permeability is with Sideshow and Quezcan soils. The pH value varied from 6.9 to 9.4 (DDD family soils in Map Unit J).

ADJACENT AREA

The Division is required to protect adjacent areas designated as alluvial valley floors, as per R645-302-320 and R645-302-322. Adjacent area is a defined term and means the area outside of the permit area where a resource or resources are or reasonably could be expected to be adversely impacted by the proposed coal mining and reclamation. As applied to an AVF determination, the adjacent area should include areas where there are characteristics used to evaluate the AVF and particularly areas where the hydrologic regime may be affected by the mining and consequently may affect an AVF.

The Applicant mapped the existence of probable alluvial valley floors along Kanab Creek (below the County road as shown on MRP Plate 5, App. 7-7), supported by the existence of irrigation structures, ponds and agricultural cattle production (MRP Section 9.1, Appendix 7-7). Agricultural production in a segment of the probable lower Kanab Creek alluvial valley floor is described in MRP Section 8.0 of App. 7-7 as 200 acres of pasture or hay that yields approximately 1 Tons/acre. The value of supreme to premium dairy quality alfalfa hay would be on the order of \$200 to 250/Ton, based upon the Utah Department of Agriculture's September 12, 2014 Market Report for Southern Utah good feeder to dairy quality hay (http://www.ams.usda.gov/mnreports/ag_gr310.txt). The total annual value of the Lamb hay crop would be approximately \$40,000.00 to \$50,000 annually. This figure does not include the \$20,000.00 to \$25,000 value of the after-crop grazing (estimated on p. 33 of App. 7-7 to be ½ Ton/acre).

PRIME FARMLAND

Regulatory Reference: 30 CFR 785.16, 823; R645-301-221, -302-270.

Analysis:

The Natural Resources Conservation Service evaluated the soils of the fee area for prime farmland status in 2012 (Appendix E). Vegetation Map 1 illustrates the north fee lease area and the location of:

- 306 acres of pasturelands (grasses), including flood plains and stream terraces
- 87 acres croplands (alfalfa, wheat, and silage).

The NRCS concluded that there were 292 acres of prime farmland soils within the north fee lease area. These soils are in NRCS Map Unit 1111 (Soils Map 8), Ustifluvents complex with 2 to 8% slopes and are actively irrigated (Soils Map 9). The prime farmland soils are map

units B, D, and G shown on Soils Map 2 of the Order II Soil Survey. The limiting factors that eliminate the remaining area of Map Unit 1111 from Prime Farmland are lack of irrigation, pH greater than 8.4 (as in Map Unit E), high concentration of carbonates (Map Unit G), low permeability (as in Map Unit A1) and slope (AVF Summary Table 2 and Soils Map 4). These map units fall into the category of Farmlands of Statewide Importance (AVF Summary Table 1).

Prime farmland within the permit area that has historically been used as cropland and that is currently being irrigated and used for agriculture is illustrated on Soil Map 9. Productivity of the prime farmland is 4 tons/acre on cropland (site V-11 shown on Vegetation Map 2) and 1,200 lbs/ac or 1/2ton/ac at sites V-10 and V-18 south of the farm road.

Findings:

The Division, in consultation with the NRCS, finds that there are 292 acres of prime farmlands in the proposed, north lease fee area. The requirements of R645-302-317.400 for soils handling and R645-302-317.500 for soil replacement will apply to the selected area described as irrigated prime farmland within the North lease fee area as shown on Soils Map 9.

HYDROLOGY of the NORTH PRIVATE LEASE AREA

The following is a list of hydrologic related maps submitted to the Division in the report to fulfill requirements as specified in R645-302-321.200:

- **AVF Map 1 – Reference Points** labels key points of interest throughout the study area.
- **Hydrology Map 1 – Floodplain Map** outlines the floodplain located around Kanab Creek within the North Private Lease.
- **Hydrology Map 2 – Water Contour Levels** displays groundwater contour levels and flow the direction of the alluvial groundwater in the North Private Lease. The water table elevation, equipotential lines, and flow lines on the map are derived from piezometer and well data within the North Private Lease. The flow direction was determined, as indicated by the Permittee, *“based on flow perpendicular to the potentiometric contours”*.
- **Hydrology Map 3 – Piezometer Water Levels & Root Depths** provides piezometer water levels and root depths at a number of locations throughout the study area. The piezometers and wells are reasonably spaced across the North Private Lease and installed within the unconsolidated sediments to give a representative sample of the unconfined aquifer’s water table, held within the Quaternary Alluvium.
- **Hydrology Map 4 – Streams & Surface Water** includes streams and surface drainage channels as well as the surface water divide in the area. Based on the map and field observations by Division staff, the entire North Private Lease area

is tributary to Kanab Creek. The only exception is a portion of the southwest corner of the North Private Lease area. Surface water runoff in this area drains into the Simpson Hollow Creek sub-drainage. This sub-drainage reports to Kanab Creek approximately 1 mile south of the North Private Lease boundary. The majority of surface runoff in the North Private Lease area generally flows north to south in a southwest orientation.

- **Hydrology Map 5 – Geologic Contacts & Unconsolidated Deposits** accurately maps the local surficial geology within the permit area based on the Utah Geological Survey (UGS) maps of the Alton Quadrangle, Utah, as well as field observations from the Permittee and drilling/soils information. The unconsolidated Quaternary Alluvium stream laid deposits within the North Private Lease are also mapped.
- **Hydrology Map 6 – Topography** provides topography of the area, including terraces. Upon review of the maps, the Division agrees with the Permittee's characterization of the flood and terrace complex of the North Private Lease and its features being the deeply incised Kanab Creek stream channel, the very narrow flood plain and stream terraces located within the incised channel and the broad terraces located on either side of Kanab Creek.
- **Hydrology Map 7 – Allocated Irrigation Water** indicates the allocation of irrigation water in North Private Lease, obtained online from the Utah State Engineer.
- **Hydrographic Map Area** provides historical use of irrigation water in the North Private Lease, obtained online from a survey conducted by the State of Utah in 1968. This map also displays local irrigation diversions, reservoirs and dams. These maps can be found online at <http://waterrights.utah.gov/cgi-bin/docview.exe?Folder=ADMAP85BK01>, sheets 02d and 04a.
- **Soil Map 5 – Irrigation Areas** delineates and provides a description of the type of irrigation taking place in the North Private Lease. Presently irrigated lands are to the north of the elk fence and to the west of Kanab Creek, using center pivot systems, wheel-lines, and hand-line sprinklers. Currently, no area within the North Private Lease is flood irrigated.
- **Soil Map 6 – Sub Irrigated Areas** indicates which areas of the North Private Lease are subirrigated areas. These areas are exclusive to the inside of the incised channels.
- **Soils Map 7 – Slopes** displays the percent slope of the study area.
- **Soils Map 9 – Prime Farmland Based on Field and Lab Analysis** delineates the prime farm land that is irrigated from the areas not irrigated.

The following information was documented in the report to fulfill the requirements of R645-302-321.240-260:

- **Documentation of areas that are or are not subirrigated** - To address this section of the regulations, the Permittee evaluated the types of vegetation/plants in the area and their water requirements. Quantitative and qualitative data has been provided for the plant communities in the North Private Lease area. Hydrologic data in Appendix B provides data on depth to groundwater; groundwater quality and surface-water quality information. Figure 2 (page 22) depicts the relationship of rooting depths, soil redox mottles, soil pH and groundwater depths for the piezometer locations and soil profile locations.
- **Documentation that areas are or are not flood irrigable** - The Permittee outlines the potential for flood irrigation in the North Private Lease area on page 23 of the report. Soils Map 7, *Slopes* depicts the slope ranges within the North Private Lease area. Tables 2A and 2B in Appendix B provide streamflow, water quality and water yield data. Water quality data for ground and surface waters is provided in Tables B-2a and B-2b in Appendix B.
- **Analysis of a series of infrared aerial photographs for vegetative growth** - The Permittee provides aerial photographs from different time-frames to evaluate the potential for sub-irrigation of local vegetation. Plants that are sub-irrigated are not as reliant on precipitation events and resulting infiltration. The Permittee provides color infra-red photographs that were analyzed to determine the potential/existence for such sub-irrigated vegetation.

The following discussion evaluates the provided information/data relative to the hydrologic requirements of an AVF. Per the requirements of R645-303-321.300, the Division will determine that an AVF exists if it finds that:

- 1) Unconsolidated stream laid deposits holding streams are present; and
- 2) There is sufficient water to support agricultural activities as evidenced by:
- 3) The existence of flood irrigation in the area in question or its historical use
- 4) The capability of an area to be flood irrigated, based on stream flow water yield, soils, water quality, and topography; or,
- 5) Sub-irrigation of the lands in question, derived from the groundwater system of the valley floor.

DESCRIPTION OF THE EVALUATION AREA

On page 3 of the report, the Permittee describes the area that was evaluated by the field investigation. The evaluation area is depicted on Hydrology Map 5, *Geological Contacts and Unconsolidated Deposits*. The area is bounded on the east and west by expansive areas of Tropic Shale bedrock. The Tropic shale extends to the eastern and western portions of the Kanab Creek valley. The Permittee states that the reasoning behind identifying the evaluation boundaries thusly is due to: 1) the low hydraulic conductivity of the Tropic Shale bedrock, and 2) the elevated topography of the Tropic Shale bedrock relative to adjacent areas. The Tropic Shale bedrock ridges on either side of the Kanab Creek Valley effectively isolating the surface

water systems atop the ridges with the groundwater systems located in the lower Kanab Creek valley. The northern and southern boundaries of the evaluation area are not clearly delineated on Hydrology Map 5, *Geological Contacts and Unconsolidated Deposits*. As a specific mine plan has not been made available to the Division, it's assumed that the evaluation area was extended adequately enough north and south in the North Private Lease Area (depicted on Hydrology Map 5, *Geological Contacts and Unconsolidated Deposits*) in order to reasonably define potential AVF's in areas of future mining activity. When the Permittee submits a proposed mining and reclamation plan for the North Private Lease Area, the Division will verify if the evaluation area was sufficiently large in scope to identify all potential AVF areas that could be impacted.

PRESENCE OF UNCONSOLIDATED STREAM LAID DEPOSITS

The Quaternary Alluvium, within the UGS map of the Alton Quadrangle, is considered to be stream laid deposits. The geologic conditions and deposits are evaluated more fully in the Divisions, geological analysis.

EVIDENCE OF FLOOD IRRIGATION IN THE AREA IN QUESTION OR ITS HISTORICAL USE

Currently, there is no evidence of flood irrigation practices being utilized in the North Private Lease area. However; flood irrigation was historically utilized to a limited extent. Mr. Raymond Heaton is a long-time resident of the town of Alton. Mr. Heaton was the President of the Alton Farmers Association for over 10 years and his lived most of his 68 years in Alton, Utah. Based upon conversations between Mr. Heaton and Division staff, Mr. Heaton indicated that flood irrigation practices were only conducted north of the Farm Road and have not been observed south of it (See AVF Map 1, *Reference Points*). Mr. Heaton indicated that he had investigated water records for the area and could not find evidence of flood irrigation practices being conducted south of the Farm Road.

Mr. Heaton further discussed that the water currently used for irrigation in the town of Alton and adjacent areas (including the North Private Lease area) is diverted from Kanab Creek via a pipeline diversion system located over 3 miles north-east of the town of Alton. Mr. Heaton indicated that the primary reason for this is due to: 1) the majority of farms in the area are located north and north-east of the town of Alton and 2) the slopes located near the town of Alton produced insufficient head to generate the gravity flow necessary for irrigation.

Through analysis of historical aerial imagery taken of the North Private Lease in 1952 through the USDA, Agricultural Stabilization and Conservation Service, (<http://geology.utah.gov/databases/imagery/>; file name "DSA_4K-108) and the 1968 Hydrographic Survey, there is further evidence that flood irrigation has occurred within the North Private Lease, determined by the presence of supply and spur ditches seen on this historical imagery.

CAPABILITY OF AREA TO BE FLOOD IRRIGATED, BASED ON STREAM FLOW WATER YIELD, SOILS, WATER QUALITY AND TOPOGRAPHY

The capability of the North Private Lease area to be flood irrigated is considered low. One of the limiting factors for flood irrigation in the North Private Lease area is the stream morphology of Kanab Creek. The channel of Kanab Creek is deeply incised. Based on field observations by Division staff, the elevation of the bottom of the stream channel of Kanab Creek is approximately 15' - 30' below the adjacent terraces. It's evident that the adjacent terraces were at one point the active flood plain areas for the Kanab Creek drainage. However; this is no longer the case. The terraces are now effectively isolated from Kanab Creek due to the incising of the channel.

As discussed previously, all water utilized for irrigation purposes in the town of Alton and adjacent agricultural areas is derived from a diversion structure several miles to the north-east of the town (i.e. water is not diverted from Kanab Creek in the immediate area of or directly adjacent to the agricultural areas of the North Private Lease area).

The Office of Surface Mining "Alluvial Valley Floor Identification and Study Guidelines" (1983) states, "*Most lands naturally adapted to flood irrigation can receive water from gravity flow sources or require pumping only to the extent of lifting water to the highest point in the field*". As a result of the incising and cutting of the Kanab Creek stream channel, extensive pumping would be required from within the incised channel in order for water from the drainage to be utilized for agricultural production in the North Private Lease area. This condition appears to contradict the aforementioned statement from the OSM AVF Guidelines that envisions water being diverted directly from the stream channel adjacent to or within the area to be irrigated.

It is unlikely that water would ever be diverted from the Kanab Creek stream channel as it passes through the North Private Lease, but water is allocated, not only to the northern areas of the North Private Lease, but also to the lands just south of the farm road and north of the elk fence. Some of the land just south of the farm road is not capable of flood irrigation, mainly due to topography, but small portions of it appear to be capable of flood irrigated through the existing irrigation company's diversion system. The Permittee must provide additional information as to why they have excluded these areas as potential AVF.

SUB-IRRIGATION OF THE LANDS IN QUESTION, DERIVED FROM THE GROUNDWATER SYSTEM OF THE VALLEY

Based on the data provided by the Permittee, there are limited amounts of groundwater available for sub-irrigation in the entire North Private Lease area. The Office of Surface Mining "Alluvial Valley Floor Identification and Study Guidelines" (OSM AVF Guidelines) states, "*Subirrigation, in terms of the alluvial valley floor regulatory program is the 'supplying of water*

to plants from underneath or from semi-saturated or saturated zone where water is available for use by vegetation”.

In an effort to determine the availability of groundwater to vegetation, the Permittee provided groundwater data from two monitoring wells and twelve piezometers completed throughout the North Private Lease area. In most instances, over a year and a half of nearly quarterly monitoring data was collected from each of the piezometers/wells. The data is provided in Appendix B, *Hydrology Info*.

Hydrology Map 3, *Piezometer Water Levels & Root Depths* depicts the locations of the piezometers where the groundwater elevation data was obtained as well as the root depths that were documented in the preparation of the report. In addition, Figure 2 provides a comparison of the rooting depths of the area vegetation along with the groundwater depths that were obtained in the preparation of the report. The depth to groundwater ranges from 12.6' to 23.5' below grade on the terrace to the west of Kanab Creek and 27.4' to more than 28.5' below grade on the terrace east of Kanab Creek. The rooting depths were reported as being from 2.5' to 4.5' below the surface. Upon review of the data, it's evident that the depth of the groundwater in the majority of the North Private Lease area precludes it's availability for vegetation.

There are two exceptions where groundwater depths would provide sub-irrigation conditions: NLP-4 and NLP-5 (See Hydrology Map 3, *Piezometer Water Levels & Root Depths*). NLP-4 is located where the active floodplain and the stream terrace meet. Of note is that the elevation of NLP-4 is very close to the elevation of Kanab Creek. NLP-5 is found slightly higher on the stream terrace compared to NLP-4. However, these monitoring points are located within the incised channel of Kanab Creek and not on the upland terrace locations adjacent to either side of the drainage.

In addition to the limited availability of groundwater for vegetation, its water quality is fairly poor. Upon review of the groundwater data provided in Appendix B, *Hydrology Info*, total dissolved solid (TDS) concentrations were relatively high. With the exception of seven water monitoring events at three different sites (Well Y-70, NLP-5 and NLP-7), all of the groundwater TDS concentrations were greater than 1,200 parts-per-million (ppm). The State of Utah irrigation standard for the area is 1,200 ppm for TDS. According to the OSM AVF Guidelines, TDS concentrations between 1,000 to 2,000 ppm produce “*Water that may have adverse effects on many crops and requires careful management practices.*”

GEOLOGY of the NORTH PRIVATE LEASE AREA

The North Private Lease area is comprised of 428 acres within Sections 12 and 13 in Township 39 S. Range 6 West and Sections 7 and 18 in Township 39 S. Range 5 West. Stratigraphic units present in the Alton North Private Lease Area are comprised of Cretaceous-age units. Exposed at the surface there are only three formations present in the study area. The

economic coal reserves exist within the Dakota Formation and are not present at the surface of the study area. . All the stratigraphic units exposed in the Alton North Private Lease area are listed in ascending order below:

Dakota Formation (Cretaceous)

The Dakota Formation is a fine to medium-grained sandstone interbedded with shale and coal. The economically viable coal seams in the Alton Coal Field are within this rock unit. In the study area, the Dakota Formation outcrops along the far western and southern boundaries. The formation dips slightly toward the Northeast at approximately 2 degrees.

Tropic Shale (Cretaceous)

The Tropic Shale consists of gray and carbonaceous silty shale and claystone with few marine sandstone beds located mostly in the upper part. The formation typically erodes to a clayey soil that forms gentle, vegetated slopes. The Tropic Shale Bedrock is present at or near the surface on both the eastern and western margins of the Kanab Creek valley in and adjacent to the North Private Lease and it's extent is shown on Hydrology Map 5 in the report. The regional thickness in this area is approximately 700 feet.

Quaternary Alluvium

The alluvium deposits in the area consist of poorly sorted alluvial and colluvial silt, clay, sand, and gravel. These deposits consist of stream and fan alluvium and terrace deposits. In downstream areas, the alluvial material consists primarily of mud derived from Tropic Shale. Within the North Private lease area the alluvial deposits vary in thickness from a thin veneer to an estimated 10 feet or more. In drill hole Y-103 an alluvial thickness of 105 feet was encountered. Most of the land surface in the North Private Lease Area consists of fan alluvium deposited from sheet floods, debris flows and mud flows.

TECHNICAL MEMO

September 16, 2014

System	Series	Stratigraphic Unit		Thickness (Feet)	Description	
Tertiary	Eocene	Claron Formation		1000-1300	Pink, white, and varicolored limestone, cliff former eroding into picturesque slopes and forms, basal conglomerate of exotic quartzite and limestone cobbles and pebbles.	
	Unconformity					
Cretaceous	Campanian	Kaiparowits Formation		265-700	Dark gray to gray-green arkosic sandstone, friable with weak calcareous cementation.	
	Unconformity					
	Santonian ? Coniacian ? Turonian	Wahweap Formation		500-1300	Alternating sandy shale and thin-to thick-bedded resistant sandstone, ledge and slope topography.	
		Straight Cliffs Formation		80-500	Yellow-gray to brown, thick-bedded to massive cliff-forming sandstone with subordinate intervening gray shale, shaley sandstone, coal and carbonaceous shale.	
		Tropic Shale		700-1000	Drab gray shale with subordinate thin brown fine-grained sandstone, slope former.	
Cenomanian	Dakota Formation		150-450	Yellow-gray to brown fine- to medium-grained sandstone alternating with gray shale, sandy shale, carbonaceous shale and coal, ledge and slope former creating Gray Cliffs; best coal near bottom and top of unit.		
Angular Unconformity						
Jurassic	Upper	Entrada Sandstone	Cannonville Member	0-300	White and reddish banded fine-grained sandstone and siltstone, friable and earthy weathering, massive.	
			Gunsight Butte Member	0-300	Red-brown and light green siltstone; also red cross-bedded sandstone of the "slickrock" type.	
		Carmel Formation	Judd Hollow Tongue of Carmel	Wiggler Wash Member	0-60	Limestone, red siltstone, white and greenish gypsum.
				Winsor Member	180-250	White, pink, brown sandstone alternating with thin red siltstone and mudstone.
				Paria River Member	55-200	Interbedded light gray and red sandstone, limestone, siltstone, shale, and gypsum.
				Thousand Pockets Tongue of Navajo Sandstone	0-60	Yellowish cross-bedded friable but resistant sandstone.
				Crystal Peak Member	120-190	Dark reddish brown and white to light gray fine-grained sandstone, medium-bedded with minor thin gypsiferous or calcareous shales and conglomerate.
				Kolob Limestone	122-350	Gray and tan dense limestone with some thin sandy red shale near the base and thin gypsum near top.
		Unconformity				
		Lower	Navajo Sandstone		1000+	Light gray to tan, locally red fine-grained sandstone, massive, exhibiting large-scale aeolian cross-bedding, calcareous and cliff forming.

Figure 1. Generalized Geologic Section of Rock Formations in the Alton Coal Field (from Doelling, 1972).

A depositional environment has been theorized for the area between 1400 AD and the late 1800 AD when the alluvial valley was formed probably by a meandering Kanab Creek. It is believed that Arroyo downcutting commenced during the mid 1880's and Kanab Creek is now deeply incised within the area of the North Private Lease. This would have caused the groundwater level in the area to drop, so at this time there is no surface water or subirrigation

occurring in the North private lease area other than that found in the deeply incised stream channels.

The delineation of the alluvial/colluvial deposits is fairly straightforward. The upland areas where the Tropic Shale bedrock is exposed are quite obvious. During a field investigation conducted on September 3, 2014, it was relatively easy to identify the geologic contacts between the alluvial valley that is mostly flat and the Tropic Shale Bedrock which starts to slope upward. The contact is accurately drawn as dark black lines on Hydrology Map 5. The Alluvial Valley is clearly contained by the Tropic Shale Bedrock that is located on the East and West periphery of the Kanab Creek Study area.

The distinction between stream laid alluvial deposits and the slope-washed colluvial deposits is not as distinct. A push probe rig was used to try to delineate the areas of colluvium. This along with the soils studies, indicate that the alluvial and colluvial deposits are somewhat intermixed along the northern and western boundaries of the study area. Hydrology Map 1 identifies the floodplain of the Kanab Creek area and approximates the boundary between the slopewash and the true alluvium. For the purposes of the study both the colluvium and the alluvium are classified as unconsolidated deposits.

While the surficial geology has been adequately depicted, there is sparse information about the stratigraphy of this area. The narrative describes approximately 105 feet of alluvium at well Y-103, but does not describe the thickness of the Tropic shale in this location nor the depth to coal. It is anticipated that the depth to coal would not be much greater than 100 feet in this area so the extent of tropic shale at this location is in question. While this information may not be crucial for the determination of an Alluvial Valley Floor, it is important to have a geological cross section of this area at such time as mine permitting occurs.

Findings:

The Kanab Creek floodplain and terrace complex is accurately delineated on Hydrology Map 5.

There are only three geologic formations exposed at the surface within the study area; the Dakota formation, the Tropic Shale and the unconsolidated Quaternary deposits (alluvium/colluvium). The Alluvial valley has been accurately depicted. The paucity of water at the surface in the study area is evidence of the incised character of Kanab Creek with very little subirrigation occurring within the study area.

Additional information will need to be submitted during any permitting action which would characterize the coal seam and the relative depths of coal and overburden. A Geologic cross section through the valley is needed.

RECOMMENDATIONS:

Upon review of the Alluvial Valley Floor Field Investigation provided by the Permittee of the North Private Lease, the Division is requesting additional information. Please provide clarification and/or additional data to address the following:

R645-302-321.322- Based on Hydrology Map 7, irrigation water is allocated to some lands just south of the farm road, and north of the elk fence. Currently, there are fields in this area that are irrigated using hand lines as outlined in Soils Map 5. Please provide further information that would demonstrate why these lands (currently irrigated lands south of the farm road and north of the elk fence) do not have the capability of being flood irrigated.

R645-302-321.200- The high and low water depths, as labeled on Hydrology Map 3 do not correspond with depths measured with the piezometers in Table B-2a, please address this discrepancy.

R645-302-321.200- Water data is provided for NLP-13 in Tables B-2a and B-2b, but this well doesn't appear on Figure 2 of page 22 of the report, Hydrology Map 3, or in Tables B-1 and B-3. Please correct this discrepancy or provide explanation as to why this well has been excluded.

R645-302-321.260- Page 9 paragraph 5, the pastures within and adjacent to Kanab creek in the lease appear to be used for grazing at least from the 9/3/2014 site visit. The text in this paragraph should be clarified based on the 9/3/2014 site visit and personal communication with the landowner or individuals responsible for grazing in the area.

Page 9 paragraph 5, 2nd italicized paragraph, it appears as though this excerpt from the OSM guidelines (1983) was included in the application under the assumption that there was a "consensus". The applicant needs to clarify this statement by providing documentation that supports this assumption.

Some of the land just south of the farm road is not capable of flood irrigation, mainly due to topography, but small portions of it appear to be capable of flood irrigated through the existing irrigation company's diversion system. The Permittee must provide additional information as to why they have excluded these areas as potential AVF.

Additional information will need to be submitted during any permitting action which would characterize the coal seam and the relative depths of coal and overburden. A Geologic cross section through the valley is needed.