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Incoming Consult

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The attached documents are from Emery permit Chapter XI

The photo is the area I would like to revisit on Thursday.

From definitions in regs.

Alluvial Valley Floors" means the unconsolidated stream-laid deposits holding streams with water availability sufficient for subirrigation or flood irrigation agricultural activities, but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits formed by unconcentrated runoff or slope wash, together with talus, or other mass-movement accumulations, and windblown deposits.

See you Thursday am

John Gefferth

CHAPTER XI ALLUVIAL VALLEY FLOORS

UMC 785.19, UMC 822

XI.A BACKGROUND

XI.A.1 FIELD INVESTIGATION

Within the Emery Mine permit area and adjacent lands, several streams exist which may qualify as Alluvial Valley Floors (AVF). These streams are: Quitchupah Creek, Christiansen Wash, Muddy Creek, and Ivie Creek. An investigation of these streams was completed by WATEC, Inc. The report of this investigation is presented as Appendix XI-1. Additional investigations were completed by Dan Kimball of Kaman Tempo Corporation. The results of the Kaman Tempo studies are presented as Appendices XI-2 and XI-3.

XI.A.2 GRANDFATHERED AREAS

The operation of the Emery Mine in Sections 28, 29, 32, and 33 T22S R6E is grandfathered under Utah and Federal laws and regulations for mining in or adjacent to alluvial valley floors. Justification of grandfathering is through the following points;

- The Emery Mine has been producing coal in commercial quantities since 1975.

- Substantial and significant financial commitments were made prior to August 3, 1977, predicated on the applicants' ability to mine coal within and adjacent to an alluvial valley floor.

These commitments are based on, and evidenced by, the Notice of Intention to Commence Mining Operations and the Mining and Reclamation Plan dated June 16, 1977 and as recognized in R. W. Daniels, DOGM, letter to Consol dated May 11, 1978. The Division of Oil, Gas, and Mining made a determination in a letter dated January 27, 1984 that the above mentioned sections are exempt from the AVF regulations. The outline of these four sections is denoted on Plate XI-1.

XI.B AVF DETERMINATION

Based on the field investigation by WATEC, Inc. and studies by Kaman Tempo Corp., each of the four streams in or adjacent to the Emery Mine permit area have been evaluated for a determination as to 1) whether an Alluvial Valley Floor exists, and 2) whether the mining operations will impact the AVF, if present. The criteria defined in UMC 785.19(c)(2) are used to determine if an AVF is present. Additional information on each of the following streams is presented in appendices XI-1, XI-2, and XI-3.

XI.B.1 MUDDY CREEK

XI.B.1.A GEOMORPHIC INFORMATION

Muddy Creek is located about two miles east of the Emery Mine permit area and flows from north to south. Based on the results of the WATEC, Inc. investigation, there are unconsolidated stream-laid deposits present along Muddy Creek (Plate 1, Appendix XI-1).

XI.B.1.B WATER INFORMATION

There is sufficient water to conduct agricultural activities as evidenced by the presence of farming along Muddy Creek above the confluence with Ivie Creek.

XI.B.1.C AVF DETERMINATION AND SURFACE EFFECTS OF MINING

A positive finding can be made for an AVF along Muddy Creek based on the presence of alluvial deposits and availability of water for flood irrigation. Consolidation Coal Company requests that the requirements of UMC 785.19 and UMC 822 be waived for the Muddy Creek AVF under UMC 785.19(c)(3). There is virtually no possibility that underground mining could impact the established agricultural activities along this AVF. The only connection between mining and this AVF area is the spring at the head of Miller Canyon which issues from the upper Ferron aquifer (1979 USGS discharge measurement of 6 gpm or about 0.01 cfs). This spring is not expected to be influenced by underground mining during the permit term. If it were to be affected by mining, its discontinuance would have no effect on the Muddy Creek AVF downstream owing to continuance of stream flow along Muddy Creek which is on the average 2 to 4 orders of magnitude greater than the discharge of this spring.

XI.B.2 IVIE CREEK

XI.B.2.A GEOMORPHIC INFORMATION

Ivie Creek is located about 2½ miles south of the Emery Mine permit area and flows from west to east and joins Muddy Creek approximately four miles southeast of the Emery Mine permit area. About two miles above the confluence with Muddy Creek, Quitchupah Creek joins with Ivie Creek. As shown on Plate 1 in Appendix XI-1, there are limited areas of alluvial deposits along Ivie Creek from its headwater area to the confluence with Muddy Creek. The valley of Ivie Creek broadens to a limited extent in the area of the confluence with Quitchupah Creek. The valley in this area is generally eroded and gullied.

XI.B.2.B WATER INFORMATION

There are no agricultural activities present along Ivie Creek. It is reported that limited flood irrigation activity was practiced immediately upstream of Ivie Creek's confluence with Quitchupah Creek at one time. This activity was discontinued most probably due to a lack of water. The water quality of Ivie Creek exhibits a very high salinity hazard and a medium sodium hazard for irrigation purposes. The soils which occur within the Ivie Creek valley floor have severe agricultural limitations due to moderate sodium hazards and shallow, droughty, or stony conditions.

XI.B.2.C AVF DETERMINATION AND SURFACE EFFECTS OF MINING

Given the poor soil and water conditions, Ivie Creek should not be classified as containing any Alluvial Valley Floors. The impacts of underground mining on any possible AVF in the Ivie Creek valley would be negligible if a positive determination were to be made.

XI.B.3 CHRISTIANSEN WASH

XI.B.3.A. GEOMORPHIC INFORMATION

Christiansen Wash flows through the northwest portion of the Emery Mine permit area and joins Quitchupah Creek near the mine portal. There are alluvial deposits located adjacent to Christiansen Wash as shown on Plate 1 in Appendix XI-1.

XI.B.3.B WATER INFORMATION

All flood irrigation which is taking place in the valley of Christiansen Wash is based on water supplied from Muddy Creek through the Emery Ditch. There has been no historic precedence for the use of Christiansen Wash water for irrigation purposes. Appendix XI-2 notes that the valley of Christiansen Wash is "too incised and deep" to utilize water directly from the wash. The amount of ditching required to bring water to the fields would not be justified given the amount of water available from the small drainage area. In responses prepared for the Division of Oil, Gas, and Mining in 1984 (Appendix XI-3 Section 3), an analysis of the water flows in Christiansen Wash and irrigation requirements shows that the majority of water flowing in Christiansen Wash is runoff from flood irrigation activities. Christiansen Wash, above the area of flood irrigation, flows only in the spring and in response to thunderstorms. The remainder of the year the stream is dry. Christiansen Wash does not provide adequate water to support flood irrigation of the adjacent alluvial lands. Christiansen Wash does not therefore meet the AVF determination criteria of UMC 785.19(c)(2).

XI.B.3.C AVF DETERMINATION

Christiansen Wash does not meet the criteria necessary to have a positive AVF determination. Although there are alluvial deposits present adjacent to the wash, Christiansen Wash does not provide adequate water for flood irrigation. Since Christiansen Wash does not qualify as an AVF, no additional protection of the surface is required beyond that presented in Chapter V, Part B Subsidence.

XI.B.4 LOWER QUITCHUPAH CREEK

XI.B.4.A GEOMORPHIC INFORMATION

Lower Quitchupah Creek is defined to be that portion of Quitchupah Creek downstream of the confluence with Christiansen Wash. Plate 1 in Appendix XI-1 shows that the geomorphic character of lower Quitchupah Creek is a narrow, deeply incised valley which widens near the confluence with Ivie Creek. The alluvial deposits in this area can be characterized as thin and eroded. This stretch is not conducive to flood irrigation due to the rugged nature of the terrain (150 foot ledges) and that little room exists for a ditch.

XI.B.4.B WATER INFORMATION

There is no evidence of historical flood irrigation along this reach of Quitchupah Creek. The Soil Conservation Service notes in Appendix XI-2 that there is no precedence in the region to flood irrigate similar valleys.

XI.B.4.C AVF DETERMINATION

Lower Quitchupah Creek does not qualify as an Alluvial Valley Floor under the UMC 785.19(c)(2) criteria.

XI.B.5 UPPER QUITCHUPAH CREEK

XI.B.5.A GEOMORPHIC INFORMATION

Upper Quitchupah Creek is defined as that portion of Quitchupah Creek above the confluence with Christiansen Wash. The upper Quitchupah Creek Valley contains unconsolidated stream-laid deposits as shown on Plate 1 of Appendix XI-1.

XI.B.5.B WATER INFORMATION

Upper Quitchupah Creek contains several areas where flood irrigation activities are ongoing. An assessment of the annual runoff indicates that sufficient water could be available from Quitchupah Creek to flood irrigate 300 to 400 acres along the Quitchupah Creek Valley. Presently the agricultural activities on the north side of Quitchupah Creek are irrigated from Muddy Creek water diverted through the Emery Ditch (Plate XI-1). The fields south of Quitchupah Creek are irrigated primarily from water diverted from Quitchupah Creek about two miles west of the permit area. The areas presently irrigated in the upper Quitchupah Creek valley are outlined on Plate XI-1.

XI.B.5.C AVF DETERMINATION AND SURFACE EFFECTS OF MINING

The areas outlined on Plate XI-1 (Areas 1-3) meet the criteria for a positive AVF determination. Area 1 is located within the grandfathered area and is therefore exempt from UMC 822.12(a) and (b). Area 2 is presently irrigated by Muddy Creek water but could potentially be irrigated with Quitchupah Creek water. Area 3 is the area presently being irrigated with Quitchupah Creek water.

Areas 2 and 3 on Plate XI-1 are subject to the protection requirements of UMC 822.12(a) requiring that the mining activities will not interrupt, discontinue, or preclude farming on AVF's unless the premining land use is undeveloped rangeland or the affected area is small and provides negligible support for farm production. The possible effect of mining under these areas would be subsidence of the surface. Subsidence could cause changes in the surface drainage patterns and thus interrupt farming operations. In order to prevent subsidence from occurring, Consolidation coal Company plans to establish a buffer zone around these AVF areas as shown in Chapter V Plate V-5. Underground mining operations within this buffer zone will be conducted using the subsidence protection methods shown in Chapter V Part B. Pillar dimensions within the buffer zone will be sized large enough to have a factor of safety of at least 1.75 thus preventing subsidence. In the event that surface disturbance occurs in Areas 1 and 2, mining operations under these areas will cease until remedial measures are taken as required by UMC 822.12(b). If subsidence occurs within the AVF areas outlined on Plate XI-1, Consol will restore the area using the methodology described in detail in Appendix XI-3.

XI.C AVF MONITORING

Hydrologic and subsidence monitoring plans are described in detail in Chapters VI and V respectively. Much of this monitoring will occur in or adjacent to the alluvial valley floor areas and would serve to demonstrate that the alluvial valley floor performance standards are being met. In order to assure that farming operations are not interrupted, discontinued, or precluded, agricultural activities will be informally monitored by mine personnel. If any change in agricultural activities is observed, the operator will investigate the cause, and the Division of Oil, Gas, and Mining will be notified.


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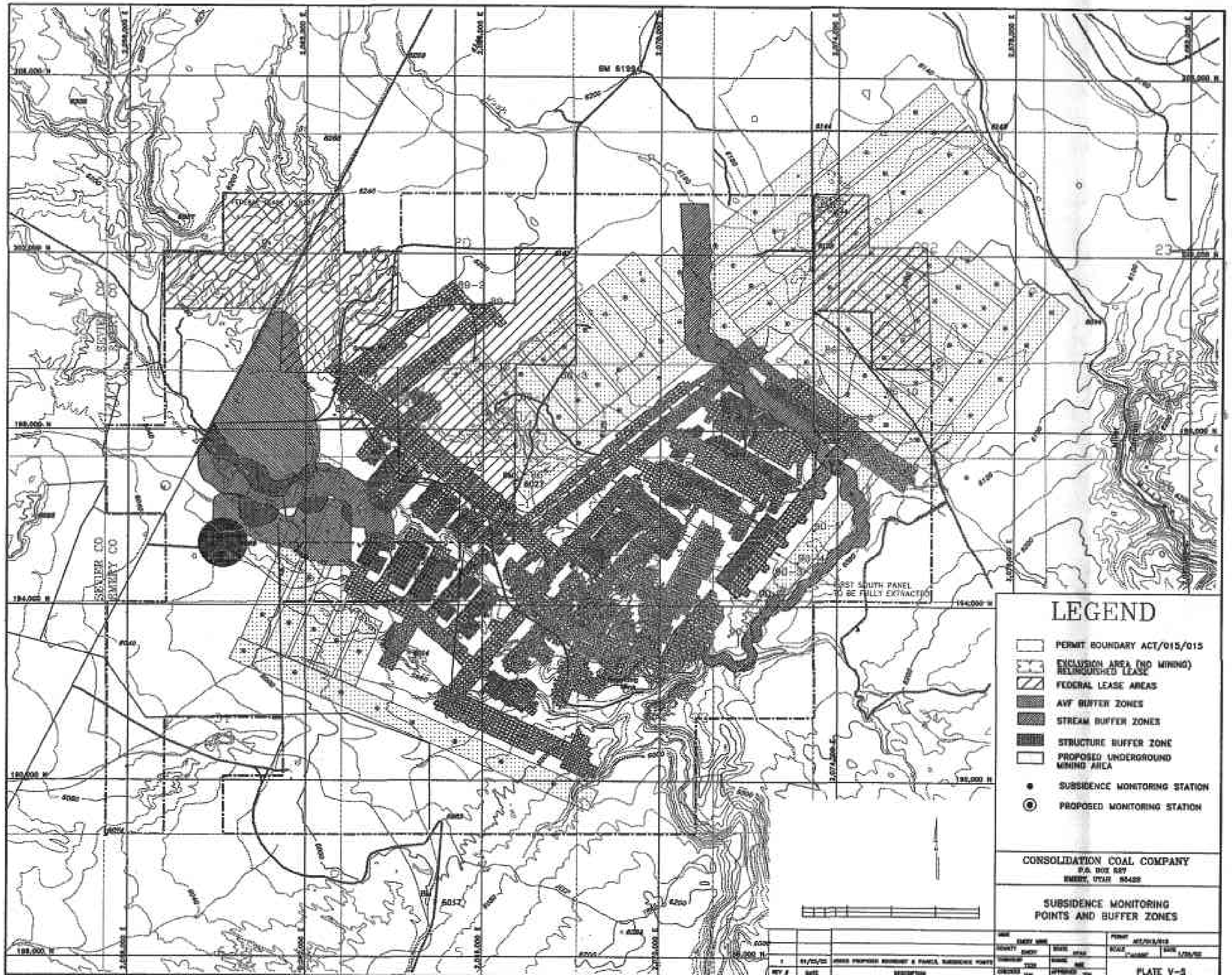
SEVIER CO
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FIRST SOUTH PANEL
TO BE FULLY EXTRACTED
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RELINQUISHED LEASE
FEDERAL LEASE AREAS
AVF BUFFER ZONES
STREAM BUFFER ZONES
STRUCTURE BUFFER ZONE
PROPOSED UNDERGROUND MINING AREA
SUBSIDENCE MONITORING STATION
PROPOSED MONITORING STATION
CONSOLIDATION COAL COMPANY
P.O. BOX 527
EMERY, UTAH 84522
SUBSIDENCE MONITORING
POINTS AND BUFFER ZONES
PLATE V-5

ALLUVIAL VALLEY FLOORS

EMERY MINE AREA

EMERY, UTAH

Stephanie: Steve C. needs this one ASAP. Thx - Priscilla

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Prepared by: WATEC, Inc.
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Aurora, Colorado 80012

5/8/80

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1.0 BACKGROUND INFORMATION

In a recent report on the hydrogeology of the Emery Mine and environs thereof (Consolidation Coal Company, 1979), the subject of alluvial valley floors was addressed under Section 9.0, Potential Hydrologic Consequences of Mining. The body of this discussion focused on the results of a Bureau of Land Management report (BLM, 1979). The BLM concluded that according to the Soil Conservation Service (SCS) in Price, Utah, and the unsuitability criteria used for qualifying known coal resource areas, there are no alluvial valley floors in the Emery area. Consolidation Coal Company (Consol), the owners and operators of the Emery Mine, concur with this conclusion. However, because of the lack of any supporting site-specific evidence provided by the BLM in their report, Consol has taken measures to provide this information. The report which follows is an addendum to Section 9.4, Alluvial Valley Floors, Emery Hydrogeological Report, Emery Mine, Emery, Utah (Consol, 1979).

2.0 METHODOLOGY AND DISCUSSION

2.1 Introduction

In order to determine the presence or absence of an alluvial valley floor which could potentially be affected by the existing Emery Mine and/or proposed Emery Mine operations, the guidelines for the technical identification and study of alluvial valley floors (OSM, 1978) were used. As a result, the procedures for an alluvial valley floor evaluation of the Emery Mine area adhere to these guidelines, utilizing where necessary all available geologic, hydrologic, soils, vegetation, and land use data.

For this alluvial valley floor evaluation, the study area includes all lands which lie within the Emery Mine permit boundary and those lands lying approximately two miles outside of the permit boundary which were determined from a color air photo and site reconnaissance study to contain stream valleys with alluvial deposits. The only exception to this statement is addressed specifically to the Quitchupah Creek drainage lying to the northwest of Utah Route 10. As illustrated on Plate 1, the Joe's Valley-Paradise Fault zone transects this area thus creating a hydrologic divide which isolates the bedrock ground water hydrologic system to the northwest from that of the southeast. Because the area to the northwest of the hydrologic divide lies approximately 0.5 mile outside of the permit boundary and the nearest coal bed proposed to be mined occurs more than 700 feet below the ground surface isolated by approximately 600 feet of essentially impermeable Bluegate Shale overburden, potential impacts from mining are nonexistent. Consequently, identification and study of the potential Quitchupah Creek valley floor lying to the northwest of the hydrologic divide are not necessary.

Figure 1 shown on the following page schematically depicts the procedure for preliminary identification of

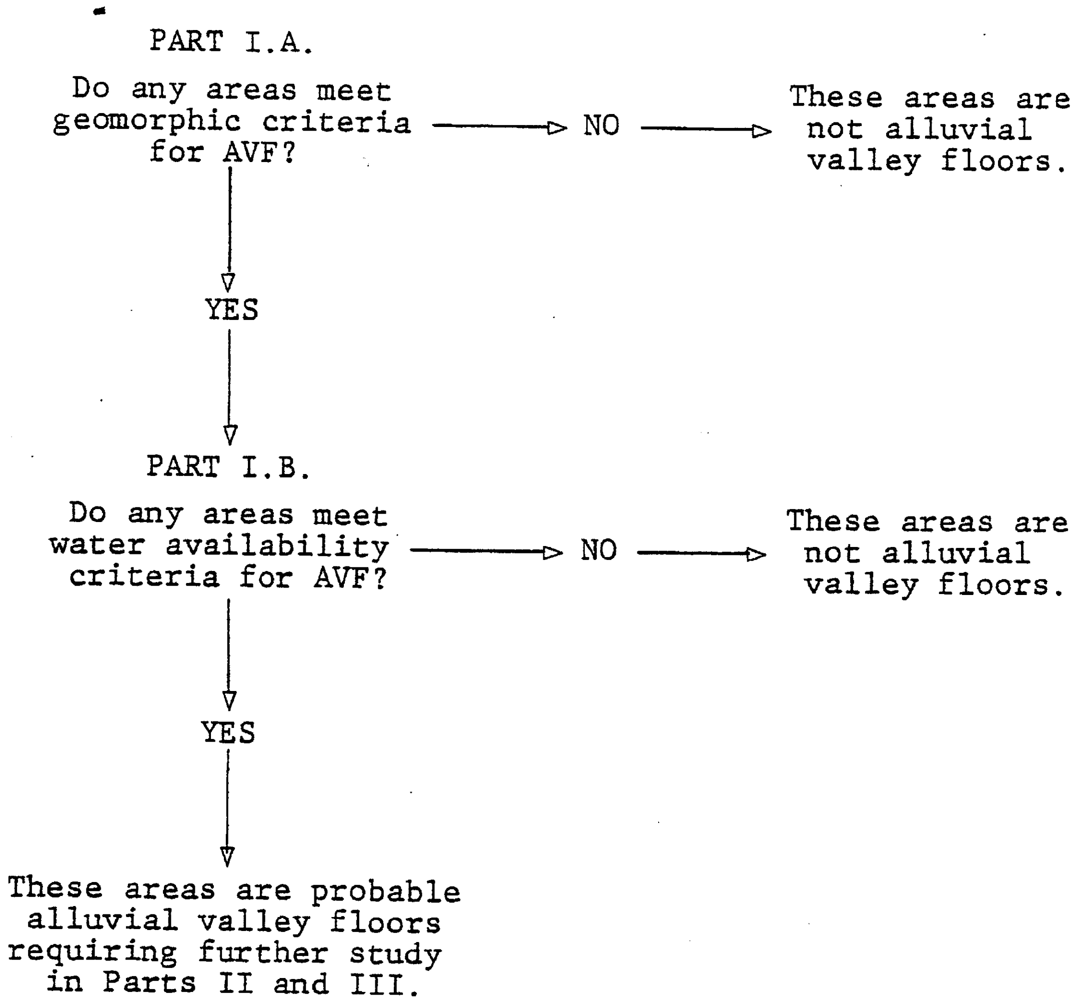

Figure 1. Diagram of procedure for preliminary identification of alluvial valley floors (Source: OSM, 1978).

alluvial valley floors within the study area. These procedures are briefly summarized below in Sections 2.2 and 2.3 and are then followed with discussions relevant to potential alluvial valley floors within the study area.

2.2 Geomorphic Characteristics, Part I.A.

Guideline Procedure

"Map all active flood plains and terraces underlain by unconsolidated material found in the lower parts of topographic valleys, in which are found identifiable stream channels. In a plan view, these terraces, together with the active flood plain and channel, would normally form one contiguous unit, separated only by minor amounts of non-alluvial materials, such as bedrock outcrops or thin layers of eolian sand or silt. Identifiable stream channels are considered here as all drainage courses shown on a USGS 1:24000 topographic quadrangle, as well as any other perennial stream channels and other drainageways at least three feet in bankfull width and/or 0.5 feet in depth at bankfull stage.

"This procedure should identify all stream laid deposits associated with an identified stream channel and exclude isolated higher terraces which cannot be construed to be a part of a "valley floor." Terrace deposits along major upland drainage divides should not be included in this identification process. The total areal extent of each deposit should be mapped, with the upslope contact drawn where the essentially flatlying stream laid deposits encounter the sloping deposits of the surrounding hillsides." (OSM, 1978)

Discussion

According to this guideline, "all active flood plains and terraces underlain by unconsolidated material found in the lower part of topographic valleys in which are found identifiable stream channels" (hereafter referred to as "alluvium" in this report) were mapped within the study area.

Available geologic maps (see Figure 6, Consol, 1979) and stereo-pair color aerial photographs (1:12000 scale) were used to map the alluvium onto a USGS topographic base map (see Plate 1). Within the study area, four perennial streams and their associated alluvial deposits were identified: Christiansen Wash, Quitchupah Creek, Ivie Creek, and Muddy Creek. In order to facilitate accurateness and completeness of geomorphic mapping, a field check was conducted resulting in only minor changes to the extent of and contact between colluvial and alluvial deposits. No attempt was made to differentiate between terrace and active flood plain deposits because of the very limited area of flood plain deposits and, more importantly, the acutely marginal agricultural value of this land (see following section on Water Availability Criteria).

In addition to all alluvial deposits mapped in the study area, colluvial, fan, and pediment deposits are also differentiated. These deposits were primarily mapped in order to show the geomorphic context in which the alluvium lies and to clarify possible ambiguities between alluvial and non-alluvial deposits. Where no surficial deposits have been mapped adjacent to the above-mentioned geomorphic units, it can be assumed that bedrock lies within these areas.

2.3 Water Availability Characteristics, Part I.B.

2.3.1 Flood Irrigation or Special Management Activities, Part I.B.1.

Guideline Procedure

"Map the perimeter of all areas identified in Part I.A. which are flood irrigated, where old flood irrigation structures, no longer in use, once supplied water to the valley floor, and all areas that were historically flood irrigated. Also map all valley floor areas where agricultural activities involve special management of the valley floor area, including all cropped or harvested lands." (OSM, 1978)

Discussion

According to the OSM discussion which follows this guideline procedure (p. 19, OSM, 1979), "Irrigation water must [emphasis added] be supplied by water diverted from the stream channel associated with the irrigable land in question, and not from another stream in another drainage basin." Muddy Creek and Quitchupah Creek are historically the only sources of waters used for agriculture within the study area (Rex Bunderson, Pers. Comm., 1980). All alluvial deposits within the Christiansen Wash drainage which have historically been flood irrigated are supplied solely by water diverted from Muddy Creek (diversion structure shown on Plate 1). Christiansen Wash has no diversion structures and has never been historically used for agriculture due to severe limitations imposed by water availability and suitability (see Figure 2). Consequently, the Christiansen Wash drainage is hereby excluded from any further alluvial valley floor considerations.

Within the Quitchupah Creek drainage, those alluvial deposits on which agricultural activities have been depicted with hatchmarks are irrigated with water diverted from both Quitchupah and Muddy Creek.

Within the Ivie Creek and Muddy Creek portions of the study area, no agricultural activities have been historically practiced.

2.3.2 Extrapolation of Irrigable Land Using Surficial Geologic Characteristics, Part I.B.2.

Guideline Procedure

"Extending downstream to the confluence with the next largest stream and upstream one-half mile from each area identified in Subpart I.B.1, map any area identified in Part I.A. which is a similar height above the channel as those areas identified in Subpart I.B.1." (OSM, 1978)

Discussion

All areas within the Quitchupah, Ivie, and Muddy Creek drainages having potentially irrigable land are shown on Plate 2. These areas are coincident with all mapped alluvial deposits within the study area.

2.3.3 Flood Irrigation Capability, Part I.B.3.

Guideline Procedure

"Map all areas that have the capability of being flood irrigated." (OSM, 1978)

Discussion

Areas which have the capability of being flood irrigated are shown on Plate 2. These areas are coincident with all mapped alluvial deposits within these drainages which heretofore have not been excluded from alluvial valley floor considerations. However, limitations on how much of these areas is capable of being flood irrigated are imposed by a number of factors: accessibility, water availability, water suitability, and practical agricultural practices.

Portions of Muddy Creek lying within two miles of the mine permit boundary, Quitchupah Creek below its confluence with Christiansen Wash, and Ivie Creek above its confluence with Quitchupah Creek are characterized by the presence of lengthy reaches of very narrow, deeply incised, alluvium-filled valley floors. These areas have extremely poor accessibility, extremely poor "gullied land" soil cover (see Part I.B.4.) and would thus require very special management practices in order to render them at all agriculturally useful. To date, these areas have been used only for undeveloped rangeland. As a result, these areas are hereby excluded from further alluvial valley floor considerations.

Quitchupah Creek flows an average of 1800 acre-feet per year (ac-ft/yr) above the upstream diversion structure noted on Plate 1 (Rex Bunderson, Pers. Comm., 1980). According to Bunderson, the amount of water which has historically been used for irrigation in the Emery area is approximately

4 ac-ft/ac. Theoretically, a maximum of 450 acres of the approximately 695 potentially irrigable acres of land could be used for agricultural activities. As pointed out in Table 2 and Part I.B.4., due to soil suitability restrictions, only 385 acres of the 695 acres could actually be used for agriculture; historically, only 308 acres have been irrigated.

It is important to point out at this time that Quitchupah Creek waters have always been supplemented with diverted Muddy Creek waters. Consequently, two important questions are brought to mind if only (emphasis added) Quitchupah Creek's water were used for agricultural purposes: (1) Would its water quality be suitable for long term agricultural productivity; and (2) would it be practically possible to store Quitchupah Creek's annual flow for the purpose of agricultural activities?

In order to answer the first question, it is necessary to take a look at the chemical quality of waters being used for agriculture in the Emery area. Water quality samples for Quitchupah Creek and Muddy Creek were taken at sites S-18 and S-7, respectively, during 1975 and 1976. Sample locations are shown on Plate 1, water quality types are plotted on Figure 2, and chemical analyses are given in Table 1. From mean specific conductivity and SAR determinations, the water quality of Quitchupah Creek is classified as a high salinity, low sodium (C3-S1) water (USDA, 1969). This classification means that, generally, the water "cannot be used on soils

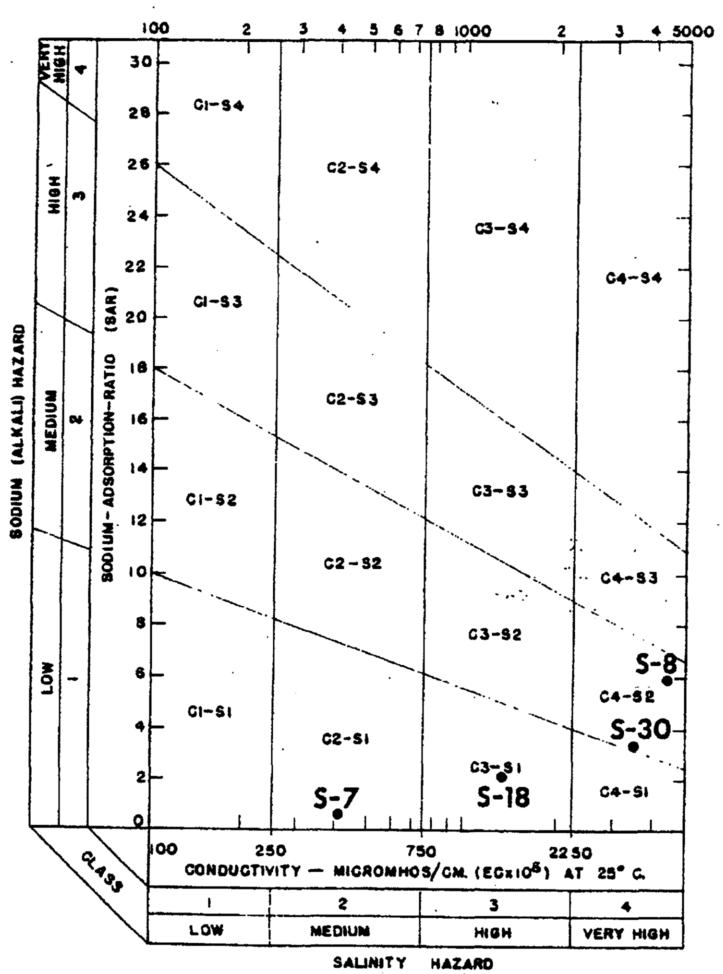

FIGURE 2. SAR - Conductivity classification of surface waters sampled in the Emery area

EXPLANATION:

Conductivity

C1 Low salinity water: Can be used for irrigation with most crops on most soils with little likelihood that soil salinity will develop.

C2 Medium salinity water: Can be used if a moderate amount of leaching occurs.

C3 High salinity water: Cannot be used on soils with restricted drainage. With adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

C4 Very high salinity water: Is not suitable for irrigation under ordinary conditions.

Sodium

S1 Low sodium water: Can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium.

S2 Medium sodium water: Will present an appreciable sodium hazard in fine-textured soils having a high cation-exchange capacity, especially under low-leaching conditions.

S3 High sodium water: May produce harmful levels of exchangeable sodium in most soils and will require special soil management--good drainage, high leaching, and organic matter additions.

S4 Very high sodium water: Is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity.

Sample Site Description

S-7 Mean of 7 samples collected between 8/26/75 and 8/12/76 on Muddy Creek diversion structure near Utah Route 10 approximately 0.5 mile west of the town of Emery.

S-8 Mean of 7 samples collected between 7/23/75 and 9/22/76 on Christiansen Wash at the Utah Route 10 crossing.

S-18 Mean of 5 samples collected between 7/23/75 and 9/22/76 on Quitchupah Creek at the Utah Route 10 crossing.

S-30 Mean of 4 samples collected between 7/23/75 and 8/11/76 on Ivie Creek 0.5 mile above its confluence with Quitchupah Creek.

Figure 2. (Continued)

TABLE 1

RESULTS OF CHEMICAL ANALYSES OF SURFACE WATER
SAMPLED IN THE EMERY MINE AREA, SITE S-7

Sample Site: S-7
Location: Canal Near Emery at U-10 (D-22-6) 9 BCB
Dates of Collection: 8/26/75 through 8/12/76
Source of Data: USGS

	No. of Samples	Mean	Standard Deviation	Max	Min
GENERAL CHARACTERISTICS					
Alkalinity, total (as $CaCO_3$)	4	192.75	16.6	217.0	180.0
Hardness (noncarbonate)	4	8.2	7.9	15.0	0.0
Hardness, total	4	197.5	12.6	210.0	180.0
Iron, diss. (Fe)	1	0.02			
Manganese, total (Mn)	2	0.05	0.07	0.01	0.0
pH, lab (units)	4	8.2	0.13	8.3	8.0
Sp. conductance, lab (μmhos/cm at 25°C)	5	405.0	44.8	475.0	360.0
Discharge (cfs)	5	14.5	11.0	32.0	2.5
Temperature (°C)	5	13.5	8.1	22.0	1.0
Total dissolved solids (TDS)	4	220.25	29.8	264.0	198.0
CATIONS					
Calcium (Ca)	4	39.5	5.25	44.0	32.0
Magnesium (Mg)	4	19.6	11.6	27.0	2.2
Potassium (K)	4	0.8	0.29	1.2	0.6
Sodium (Na)	4	9.8	6.9	20.0	5.0
Sodium adsorption ratio (SAR)	4	0.3	0.2	0.6	0.2
ANIONS					
Bicarbonate (HCO_3)	4	235.25	20.4	265.0	219.0
Carbonate (CO_3)	4	0.0	0.0	0.0	0.0
Chloride (Cl)	4	3.2	1.8	5.9	2.2
Fluoride (F)	4	0.3	0.0	0.3	0.3
Sulfate (SO_4)	4	19.0	8.8	32.0	13.0
MACRONUTRIENTS					
Nitrate + Nitrite as N	4	0.44	0.08	0.56	0.38
Phosphorus, total as P	4	0.02	0.05	0.09	0.0
TRACE AND OTHER ELEMENTS					
Arsenic (μg/ℓ,As)	1	0.0			
Boron (μg/ℓ,B)	4	25.0	5.8	30.0	20.0
Lead (μg/ℓ,Pb)	1	0.0			
Lithium (μg/ℓ,Li)	1	20.0			
Selenium (μg/ℓ,Se)	1	0.0			
Silica, diss. (SiO_2)	4	5.13	0.88	6.3	4.4
Strontium (μg/ℓ,Sr)	1	420.0			

REMARKS

1) All results are in milligrams per liter (mg/ℓ) unless otherwise noted.

TABLE 1

RESULTS OF CHEMICAL ANALYSES OF SURFACE WATER
SAMPLED IN THE EMERY MINE AREA, SITE S-8

Sample Site:	S-8
Location:	Christiansen Wash at U-10 Near Emery (D-22-6) 17 CAC
Dates of Collection:	7/23/75 through 9/22/76
Source of Data:	USGS

	No. of Samples	Mean	Standard Deviation	Max	Min
GENERAL CHARACTERISTICS					
Alkalinity, total (as $CaCO_3$)	7	330.1	94.8	421.0	222.0
Hardness (noncarbonate)	7	1350.7	1165.0	2700.0	14.0
Hardness, total	7	1678.6	1252.3	3100.0	250.0
Iron, diss. (Fe)	4	0.17	0.12	0.3	0.04
Manganese, total (Mn)	4	0.12	0.10	0.26	0.01
Oxygen, diss. (DO)	1	9.4			
pH, lab (units)	7	8.0	0.15	8.2	7.8
Sp. conductance, lab (µmhos/cm at 25°C)	7	4580.0	3456.0	8510.0	580.0
Discharge (cfs)	7	0.68	1.29	3.5	0.01
Temperature (°C)	7	15.9	8.3	24.5	0.0
Total dissolved solids (TDS)	7	3986.4	3223.0	7410.0	298.0
CATIONS					
Calcium (Ca)	7	292.1	204.2	500.0	50.0
Magnesium (Mg)	7	228.0	179.2	450.0	29.0
Potassium (K)	7	6.9	5.1	12.0	0.8
Sodium (Na)	7	655.1	575.5	1400.0	17.0
Sodium adsorption ratio (SAR)	7	5.9	4.3	11.0	0.5
ANIONS					
Bicarbonate (HCO_3)	7	402.7	115.4	513.0	271.0
Carbonate (CO_3)	7	0.0	0.0	0.0	0.0
Chloride (Cl)	7	44.7	35.3	84.0	3.8
Fluoride (F)	7	0.6	0.24	0.8	0.3
Sulfate (SO_4)	7	2542.7	2168.0	4700.0	49.0
MACRONUTRIENTS					
Nitrate + Nitrite as N	7	2.0	1.4	4.1	0.5
Phosphorus, total as P	7	0.01	0.02	0.03	0.0
TRACE AND OTHER ELEMENTS					
Aluminum (µg/ℓ,Al)	3	33.3	20.8	50.0	10.0
Arsenic (µg/ℓ,As)	3	0.33	0.58	1.0	0.0
Boron (µg/ℓ,B)	7	532.8	430.6	1000.0	30.0
Lead (µg/ℓ,Pb)	3	2.0	2.0	4.0	0.0
Lithium (µg/ℓ,Li)	3	380.0	305.1	590.0	30.0
Selenium (µg/ℓ,Se)	3	10.0	10.0	20.0	0.0
Silica, diss. (SiO_2)	7	7.9	3.0	13.0	5.3
Strontium (µg/ℓ,Sr)	4	2722.5	1502.5	3700.0	490.0

REMARKS

1) All results are in milligrams per liter (mg/ℓ) unless otherwise noted.

TABLE 1

RESULTS OF CHEMICAL ANALYSES OF SURFACE WATER
SAMPLED IN THE EMERY MINE AREA, SITE S-18

Sample Site: S-18
Location: Quitchupah Creek at U-10 Near Emery (D-22-6) 30 BDD
Dates of Collection: 7/23/75 through 9/22/76
Source of Data: USGS

	No. of Samples	Mean	Standard Deviation	Max	Min
GENERAL CHARACTERISTICS					
Alkalinity, total (as $CaCO_3$)	6	287.2	67.2	371.0	208.0
Hardness (noncarbonate)	6	308.8	172.1	470.0	73.0
Hardness, total	6	595.0	210.0	820.0	280.0
Iron, diss. (Fe)	2	0.01	0.01	0.02	0.0
Manganese, total (Mn)	2	0.05	0.06	0.10	0.01
pH, lab (units)	6	8.1	0.5	8.9	7.6
Sp. conductance, lab (µmhos/cm at 25°C)	7	1345.7	396.6	1740.0	640.0
Discharge (cfs)	7	0.8	0.9	2.0	0.01
Temperature (°C)	7	16.1	7.3	23.0	1.5
Total dissolved solids (TDS)	7	938.8	293.6	1290.0	400.0
CATIONS					
Calcium (Ca)	6	117.5	64.4	200.0	55.0
Magnesium (Mg)	6	59.5	16.5	77.0	35.0
Potassium (K)	6	4.5	1.3	5.7	2.0
Sodium (Na)	6	111.7	39.7	160.0	40.0
Sodium adsorption ratio (SAR)	6	2.2	0.9	3.3	1.0
ANIONS					
Bicarbonate (HCO_3)	6	350.2	81.9	452.0	254.0
Carbonate (CO_3)	6	0.0	0.0	0.0	0.0
Chloride (Cl)	6	37.8	13.7	52.0	14.0
Fluoride (F)	6	0.4	0.05	0.4	0.3
Sulfate (SO_4)	6	405.0	182.0	620.0	120.0
MACRONUTRIENTS					
Nitrate + Nitrite as N	6	0.4	0.4	1.0	0.0
Phosphorus, total as P	6	0.02	0.02	0.06	0.0
TRACE AND OTHER ELEMENTS					
Aluminum (µg/ℓ,Al)	2	30.0	0.03	30.0	30.0
Arsenic (µg/ℓ,As)	2	0.5	0.7	1.0	0.0
Boron (µg/ℓ,B)	6	203.3	65.3	250.0	80.0
Lead (µg/ℓ,Pb)	2	0.5	0.7	1.0	0.0
Lithium (µg/ℓ,Li)	2	80.0	14.1	90.0	70.0
Selenium (µg/ℓ,Se)	2	1.0	0.0	1.0	1.0
Silica, diss. (SiO_2)	6	10.7	2.5	13.0	7.5
Strontium (µg/ℓ,Sr)	2	1450.0	212.1	1600.0	1300.0

REMARKS

1) All results are in milligrams per liter (mg/ℓ) unless otherwise noted.

TABLE 1

RESULTS OF CHEMICAL ANALYSES OF SURFACE WATER
SAMPLED IN THE EMERY MINE AREA, SITE S-30

Sample Site: S-30
Location: Ivie Creek Above Quitchupah Creek (D-23-6) 16 CDA
Dates of Collection: 7/23/75 through 8/11/76
Source of Data: USGS

	No. of Samples	Mean	Standard Deviation	Max	Min
GENERAL CHARACTERISTICS					
Alkalinity, total (as $CaCO_3$)	3	199.7	12.7	214.0	190.0
Hardness (noncarbonate)	3	1243.3	533.5	1600.0	630.0
Hardness, total	3	1440.0	539.3	1800.0	820.0
Manganese, total (Mn)	3	213.3	86.2	290.0	120.0
pH, lab (units)	3	8.1	0.06	8.2	8.1
Sp. conductance, lab (µmhos/cm at 25°C)	4	3267.5	927.9	4190.0	2030.0
Discharge (cfs)	6	0.95	0.92	2.5	0.0
Temperature (°C)	4	15.4	12.7	26.0	0.0
Total dissolved solids (TDS)	4	2610.0	928.4	3580.0	1420.0
CATIONS					
Calcium (Ca)	3	220.0	81.8	290.0	130.0
Magnesium (Mg)	3	213.3	86.2	290.0	120.0
Potassium (K)	3	9.9	2.9	12.0	6.6
Sodium (Na)	3	310.0	151.0	450.0	150.0
Sodium adsorption ratio (SAR)	3	3.5	1.2	4.6	2.3
ANIONS					
Bicarbonate (HCO_3)	3	243.7	15.3	261.0	232.0
Carbonate (CO_3)	3	0.0	0.0	0.0	0.0
Chloride (Cl)	3	123.0	38.4	150.0	79.0
Fluoride (F)	3	0.4	0.06	0.4	0.3
Sulfate (SO_4)	3	1666.7	776.7	2300.0	800.0
MACRONUTRIENTS					
Nitrate + Nitrite as N	3	0.05	0.07	0.13	0.0
Phosphorus, total as P	3	0.07	0.10	0.18	0.0
TRACE AND OTHER ELEMENTS					
Boron (µg/ℓ,B)	3	500.0	206.6	670.0	270.0
Silica, diss. (SiO_2)	3	13.7	1.5	15.0	12.0

REMARKS

1) All results are in milligrams per liter (mg/ℓ) unless otherwise noted.

with restricted drainage. With adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected." On the other hand, Muddy Creek water which is used as a major supplement to Quitchupah Creek water shows a medium salinity, low sodium (C2-S1) water which "can be used if a moderate amount of leaching occurs." Although Quitchupah Creek water has never been solely used for irrigation, it is reasonable to assume from the above discussion that long term use of Quitchupah Creek water would pose a significant salinity hazard to agricultural productivity.

In order to answer the second question, it is necessary to take a look at the practicality of storing Quitchupah Creek's annual flow. Quitchupah Creek is fed by mountain waters derived and generated primarily from spring snowmelt runoff. In order for this water to be captured and used for irrigation, a fairly sizable and consequently expensive reservoir would have to be constructed. In view of the present-day limited agricultural use of the area and potential salinity hazards posed by long term use of Quitchupah Creek waters, a prudent man would not consider such an endeavor.

Water quality data for the upstream reaches of Ivie Creek are nonexistent, and data are limited for its downstream reaches. At site S-30 located approximately 0.5 mile above its confluence with Quitchupah Creek, samples collected during 1975 and 1976 show that Ivie Creek is a very high salinity, medium sodium (C4-S2) water (see Figure 2). At this location, Ivie Creek is not suitable for irrigation under ordinary conditions and will present an appreciable sodium hazard in fine-textured soils having a high cation-exchange capacity, especially under low leaching conditions. As evidenced in many of the streams throughout the Emery area, a downstream increase in specific conductivity and SAR is a common water quality trend (Consol, 1979). Thus, it is reasonable to assume that waters upstream from site S-30 are probably better suited for irrigation, but not significantly enough to make any difference in agricultural usefulness. As will be shown in the following section, Part I.B.4., soils which occur within the Ivie Creek valley floor have very severe agricultural limitations due to moderate sodium hazards and shallow, droughty, or stony conditions.

Average annual flow for Ivie Creek is not known. However, flow is probably somewhat lower than that of Quitchupah Creek. By comparing the mean of seven discharge measurements taken on Quitchupah Creek at site S-18 to the mean of six discharge measurements taken on Ivie Creek at site S-30, the mean discharges were 0.8 and 0.95 cfs, respectively. Keeping in mind that potential points of diversion on Ivie Creek for agricultural usage would be approximately 5 linear miles upstream from site S-30, it is expected that flows in this upstream area would be substantially less. In conclusion, given the facts that historically there has been no agriculture in the Ivie Creek study area, and water quality will probably pose a long term salinity and sodium hazard to the agricultural usefulness of the land, the flood irrigation capability of the upstream reaches of Ivie Creek is essentially non-existent.

2.3.4 Vegetation Characteristics Which May Indicate Subirrigation or Flood Inundation, Part I.B.4.

Guideline Procedure

"Based on a reconnaissance vegetation survey and use of aerial photography, map all other areas where agriculturally-useful vegetation is dependent on moisture supplied by ground water or frequent flood flows." (OSM, 1978)

Discussion

Infrared aerial photographs (1:36000 scale) provided by the Office of Surface Mining, Denver, Colorado (OSM, 1978), were flown for the Emery area on September 21, 1978. From these photos, no areas located in potential alluvial valley floors were found to be subirrigated.

In lieu of a site-specific vegetative study of Ivie and Quitchupah Creek's alluvium-filled valleys which might be designated as alluvial valley floors, a detailed soil survey (SCS, 1970) was used and deemed sufficient for determining the presence of agriculturally useful vegetation. A summary of all soil information pertinent to those areas of Quitchupah Creek and Ivie Creek shown on Plate 2 is given in Table 2.

TABLE 2

SOILS INFORMATION SPECIFIC TO THOSE AREAS OF QUITCHUPAH AND IVIE CREEKS SHOWN ON PLATE 2 (SOURCE: FROM SCS, 1970)

Alluvium-Filled Drainage	Map Symbol	Mapping Unit	Capability Unit		Range Site	Acreage	Potential Irrigable Acreage[1]
			Nonirrigated	Irrigated			
Quitchupah Creek	BeB	Beebe loamy fine sand, 1 to 3 percent slopes	VIIe-D6	IVs-26	Desert sandy loam	16	16
	BIB	Billings silty clay loam, 1 to 3 percent slopes	VIIs-D	IIIe-25	Desert loam bottom	23	23
	BIC2	Billings silty clay loam, 1 to 6 percent slopes, eroded	VIIe-D	-----	Desert loam bottom	66	0
	CBF2	Chipeta-Badland association, 3 to 30 percent slopes, eroded	VIIe-D3	-----	Desert shale	1	0
	Gu	Gullied land	VIIIe-2	-----	-------	99	0
	Hn	Hunting loam	-----	IIIw-2	-------	28	28
	KIC2	Killpack clay loam, 3 to 6 percent slopes, eroded	VIIe-2	VIe-23	Desert loam bottom	13	13
	Mx	Mixed alluvial land	VIw-2	-----	Wet stream bottom	6	0
	PeB	Penoyer loam, 1 to 3 percent slopes	VIIc-D	IIe-2	Desert loam bottom	29	29
	Ra	Rafael silty clay loam	VIIw-28	-----	Wet meadow	22	0
	RIB	Ravola loam, 1 to 3 percent slopes	VIIe-D	IIe-2	Desert loam bottom	276	276
	Sa	Saltair silty clay loam	VIIw-28	-----	Salt meadow	106	0
	Sn	Shaly colluvial land	VIIs-DX	-----	Desert cobbly loam	10	0
					Total	695	385
Ivie Creek	Gu	Gullied land	VIIIe-2	-----	-------	303	0
	PvB2	Penoyer very fine sandy loam, alkali, 1-3% slopes, eroded	VIIe-D6	IVs-28	Desert sandy loam	316	316
					Total	619	316

[1]Potential irrigable acreage does not consider suitability of irrigation waters.

non-irrigated

The capability classes of the soils listed in Table 2 range from VI to VIII. Class VI soils have severe limitations that generally make them unsuited to cultivation and limit their use largely to pasture range, or wildlife food and cover. Class VIII soils have limitations that preclude their use for commercial plant production and restrict their use to wildlife.

Range site classification of the soils in the Emery area indicates that the soils are generally in very poor to fair condition. This means that the existing range site has less than 50 percent of the vegetative characteristics of the potential vegetation, or that on the site originally (SCS, 1970). Consequently, 50 percent of the original or potential vegetation, i.e., decreasers, have been replaced by less palatable increasers and worthless invaders.

The only two important soils which are presently being used for agriculture within the Quitchupah Creek valley study area are the Ravola loam, 1 to 3 percent slopes (map symbol RIB), and the Penoyer loam, 1 to 3 percent slopes (map symbol PeB). Approximately 298 acres of alluvium mantled with these soils are presently being used for agriculture. The four other soils on which agricultural activities could potentially take place comprise a total of 80 acres which are scattered amongst six areas. These four soils are generally classified according to their capability unit as needing special management if they are to be at all productive.

The Ravola and Penoyer loams have historically been dependent on a mix of diverted Muddy Creek and Quitchupah Creek water. As previously mentioned, the seasonal nature of Quitchupah Creek precludes use of its water throughout the growing season. However, if Quitchupah Creek water were made available (see Part I.B.3.), it is expected that because of its high salinity (see Figure 2), sole use of Quitchupah Creek water for flood irrigation would pose a long term salinity hazard to the Ravola and Penoyer loams especially to the Ravola loam which has inherently slight to moderate salinity (SCS, 1970).

Within the Ivie Creek valley floor, only two soil types are present: Gullied land (Gu) and Penoyer very fine sandy loam, 1 to 3 percent slopes, eroded (PvB2).

According to its capability unit, Gullied land is classified as VIIIe-2 (nonirrigated) and consequently has little potential for the production of vegetation. Small areas can be used for grazing but the main use of this land type is for wildlife habitat.

Penoyer very fine sandy loam is primarily used for range if nonirrigated (capability unit VIIe-D6). If irrigated (capability unit IVs-28), small acreages can be used for grains and alfalfa if good control over application of irrigation water is possible. However, in view of the fact that the irrigation classification of Ivie Creek water is C4-S2 (see Figure 2) and the fact that this soil is strongly affected by alkali below a depth of 6 inches and has moderate salinity hazard, these soils are clearly ill-suited for long term agricultural usage.

3.0 SUMMARY

3.1 Introduction

Using procedures for preliminary identification of alluvial valley floors (OSM, 1978), four stream valleys in proximity to existing and proposed Emery Mine operations were evaluated: Christiansen Wash, Muddy Creek, Ivie Creek, and Quitchupah Creek. Of these four valleys lying within the study area (see Section 2.1 for study area description), none were designated as alluvial valley floors. The reasons for a negative alluvial valley floor declaration for each valley follow.

3.2 Christiansen Wash

Within the study area Christiansen Wash is not designated as an alluvial valley floor for the following reasons:

(1) All alluvial deposits associated with Christiansen Wash have historically been irrigated with diverted Muddy Creek water;

(2) Christiansen Wash has no diversion structures and has never been diverted for agricultural purposes;

(3) Christiansen Wash has very severe water quality limitations. Because its water is classified as

C4-S2, a very high salinity, medium sodium hazard would be imposed upon crops grown on its soil. In view of this situation, if Christiansen Wash were developed with a reservoir for irrigation purposes, it is highly unlikely that it could provide agriculturally useful water for the next twenty years, a period of usefulness suggested by the technical guidelines;

(4) Christiansen Wash may provide adequate quantities of water for limited irrigation use, but the flow of water upstream of Utah Route 10 is ephemeral and seasonal. Consequently, a reservoir would need to be built. Considering water quality limitations, a prudent man would never undertake such an endeavor.

3.3 Muddy Creek

Within the study area Muddy Creek is not designated as an alluvial valley floor for the following reasons:

(1) That portion of Muddy Creek lying within two miles of the permit boundary has no diversion structures and has never been diverted for agricultural use. Muddy Creek has historically been diverted for limited flood irrigation near its confluence with Ivie Creek. However, this area lies more than two and a half miles from the permit boundary and by

virtue of this proximity is considered to be hydrologically removed from any proposed mining operations;

(2) Muddy Creek is characterized by the presence of lengthy reaches of very narrow, deeply incised stream valleys. Because these areas have extremely poor accessibility and extremely poor soil cover, they can be used only for undeveloped rangeland.

3.4 Ivie Creek

Within the study area, Ivie Creek is not designated as an alluvial valley floor for the following reasons:

(1) Ivie Creek has no diversion structures and has never been diverted for agricultural use within the study area;

(2) Ivie Creek is characterized by the presence of lengthy reaches of very narrow, deeply incised stream valleys. Because these areas have extremely poor accessibility and extremely poor soil cover, they can be used only for undeveloped rangeland;

(3) At potential upstream points of diversions, Ivie Creek probably has severe water quality limitations as indicated by its downstream water quality classified as C3-S1, a high salinity, low sodium hazard water. If water at all closely similar to this quality were used on soils described as having limited potential irrigability (see (5) below), it

is highly unlikely that any long term agricultural usefulness could be wrought from the Ivie Creek alluvium-filled valley;

(4) Ivie Creek may provide adequate quantities of water for limited irrigation use, but the flow of water is seasonal. Consequently, a reservoir would need to be built. Considering water quality limitations, a prudent man would never undertake such an endeavor;

(5) The only agriculturally useful soil found within the Ivie Creek study area is the Penoyer very fine sandy loam. According to its capability unit classification, if irrigated, small acreages of this soil can be used for grains and alfalfa if good control over application of irrigation water is possible in order to reduce salinity. However, because this soil is strongly affected by alkali below a depth of 6 inches, has an inherent moderate salinity hazard, and would probably be irrigated with a water imposing a high salinity hazard, this soil is not suited for long term agricultural use.

3.5 Quitchupah Creek

Within the study area, Quitchupah Creek is not designated as an alluvial valley floor for the following reasons:

(1) All alluvial deposits associated with Quitchupah Creek have historically been irrigated with both

diverted Muddy Creek and Quitchupah Creek waters. The locations of the diversion structures are shown on Plate 1. Quitchupah Creek has not historically been used exclusively for flood irrigation within the study area;

(2) The quality of Quitchupah Creek water is classified as C3-S1, a high salinity, low sodium water. Because Quitchupah Creek water has always been greatly supplemented with Muddy Creek water, the long term effect of Quitchupah Creek water upon the agricultural productivity of its alluvial deposits is unknown. However, it is expected that its long term use would pose a significant salinity hazard;

(3) Above the Utah Route 10 crossing, Quitchupah Creek provides an average of 1800 acre feet of water annually. Because of the seasonal nature of its flow and the lack of any existing storage facilities, only a small portion of Quitchupah Creek flow is diverted for agricultural purposes. Consequently, a storage reservoir would need to be built. Considering the economics of this venture versus the questionable potential to irrigate a maximum of 385 acres of land with water having a high salinity hazard, a prudent man would not undertake such an endeavor.

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Appendix XI-2

Alluvial Valley Floor Assessment Emery Mine Area

Note: References in this document to Plate 8 should be changed to Plate 1, Appendix XI-1

Alluvial Valley Floor Assessment

Emery Mine Area

by

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ALLUVIAL VALLEY FLOOR ASSESSMENT
EMERY MINE AREA
CONSOLIDATION COAL COMPANY

Introduction

The purpose of this report is to respond to questions related to potential alluvial valley floors (AVFs) in the area of the Emery Mine of Consolidation Coal Company. More specifically, this report describes regional irrigation practices in Emery and Carbon Counties in central Utah and also evaluates three drainages in the area of the Emery Mine (Quitchupah Creek, Ivie Creek, and Christiansen Wash) in terms of these regional irrigation practices. This report also presents additional information with respect to AVF characteristics of these drainages and utilizes this information along with the identified regional irrigation practices to make AVF determinations.

Regional Flood Irrigation Practices

In order to assess regional irrigation practices in the area of the Emery Mine, Consolidation Coal Company conducted interivews with staff of the U.S. Soil Conservation Service (SCS) in Price, Utah and also with a representative of a local irrigation company in Emery, Utah. The objective of these interviews was to define regional irrigation practices in Carbon and Emery Counties and to ascertain whether these practices would be applicable to drainages and valleys in the area of the Emery Mine. Interivews were conducted on September 29, 1983, with Mr. Gary Moreau (Mine Reclamation

Coordinator) and Mr. Bob Fish (Soil Scientist) of the SCS in Price and with Mr. Clyde Mortenson (Muddy Creek Irrigation Company) in Emery. These individuals are considered to be recognized experts with respect to regional irrigation practices in the area of the Emery Mine.

Based on these interviews, it is evident that the standard flood irrigation practice in Emery and Carbon Counties is to build storage reservoirs on the major perennial streams in the area and to develop widespread ditch systems to distribute stored irrigation waters. This practice is clearly shown on the Canals and Irrigated Cropland Map for the Price and San Rafael River Basins (U.S. Department of Agriculture, June 1981). Development of storage reservoirs on the larger perennial streams is undertaken to provide a more dependable supply of water and also to provide additional irrigation water to enhance agricultural productivity. Messrs. Moreau and Fish pointed out that irrigated lands in the region provide crops almost exclusively for winterfeed for livestock and that the additional irrigation water provided by storage reservoirs generally results in an extra cutting of hay. However, they also noted that limited areas exist, primarily in the headwater areas, where spring flood flows are diverted directly from the smaller perennial streams (without storage facilities) to irrigate valley areas adjacent to these streams. Such irrigated areas may be as small as 10 acres. However, they emphasized that these areas are the exception rather than the rule (see Canals and Irrigated Cropland Map) and that they are generally dependent on diversion and ditch systems which were constructed many years ago. Messrs. Moreau and Fish also noted that under today's economic conditions, farmers in the region would generally not construct an irrigation system for a farm unless dependable irrigation water could be obtained from a storage reservoir on one of the larger perennial streams in the area. However, depending on site-specific physical and economic circumstances, direct stream diversions and irrigation of adjacent valley areas are feasible on a limited basis. They pointed out that such physical features as topography, soils, and water quality and quantity would be important site-specific factors for flood irrigability. (Messrs. Moreau's and Fish's specific comments with respect to the potential for flood irrigation in the valleys of Quitchupah Creek, Ivie Creek, and Christiansen Wash from the standpoint of regional flood irrigation practices are presented below in the discussion of each valley.)

Clyde Mortenson's comments with regard to regional flood irrigation practices were very similar to those of Messrs. Moreau and Fish. According to Mr. Mortenson, agriculture in the region is very dependent on irrigation from storage reservoirs. He did note that Muddy Creek does not yet have such a reservoir; however, one is planned in the near future (when funding is available). Mr. Mortenson noted that there is limited irrigation based on direct diversions from smaller perennial streams. However, given the uncertainties involved in receiving adequate irrigation water from such diversions, the standard practice in the region is to take advantage of irrigation water available directly from the larger perennial streams (e.g., Muddy Creek) or from storage reservoirs (e.g., Millsite Reservoir, Joe's Valley Reservoir, Huntington Lake, and Scofield Reservoir). (Mr. Mortenson's specific comments relative to flood irrigation potential in the valleys of Quitchupah Creek, Ivie Creek, and Christiansen Wash are presented below.)

Quitchupah Creek

The evaluation of the valley of Quitchupah Creek in the area of the Emery Mine with respect to AVFs has been divided into two areas, above the confluence with Christiansen Wash to the Joe's Valley - Paradise Fault Zone and below the confluence with Christiansen Wash to the confluence of Quitchupah and Ivie Creeks. The AVF characteristics of these two areas are discussed separately below.

Quitchupah Creek above confluence with Christiansen Wash. As indicated on Plate 8, this portion of the valley of Quitchupah Creek has relatively broad areas of alluvium (i.e., unconsolidated streamlaid deposits) and also areas of active flood irrigated agriculture. These areas are irrigated by water supplied from Muddy Creek and delivered by the Emery Ditch and also by water diverted directly from Quitchupah Creek. As indicated on Plate 8, the Emery Ditch irrigates fields to the north of Quitchupah Creek and upper fields to the south of the creek. Quitchupah Creek irrigates fields approximately 1.5 miles upstream of the permit boundary and also a field owned by Mr. Jack Lewis in the southwest corner of Section 29 and the southeast corner of Section 30 (T22S,R6E) immediately to the west of the Emery Mine.

According to Mr. Mortenson, the Emery and Quitchupah Creek ditch systems operate independently; however, if sufficient irrigation water is not available from Quitchupah Creek, Mr. Lewis' field could be irrigated by the Emery Ditch. Mr. Mortenson noted that Muddy Creek water was brought into the Quitchupah Creek valley to provide a more dependable supply of irrigation water and to obtain an extra cutting of hay and/or grain.

In terms of AVF designation, the valley of Quitchupah Creek (upstream of the confluence with Christiansen Wash) meets the AVF geomorphic criteria as indicated by the extent of unconsolidated streamlaid deposits (Qal) shown on Plate 8. With regard to the AVF water availability criteria, the valley of Quitchupah Creek in this area has sufficient water for flood irrigation agricultural activities as evidenced by on-going irrigation activities which utilize Quitchupah Creek water. As pointed out in previous submittals by Consolidation Coal Company, areas which are presently flood irrigated with waters from Muddy Creek do not qualify as actively flood irrigated AVFs since this water is from another drainage basin. However, as shown on Plate 8, areas in the Quitchupah Creek valley which are underlain by unconsolidated streamlaid deposits (and which may presently be flood irrigated with Muddy Creek water) have the potential to be flood irrigated by water from Quitchupah Creek since sufficient water is available to flood irrigate 300 to 400 acres in the Quitchupah Creek valley (based on an assessment of annual runoff). It should be noted that the area of the Quitchupah Creek valley which is potentially flood irrigable from a geomorphic standpoint contains soils which are not typically irrigated in the area (e.g., soils of the Ravola-Bunderson Complex and the Saltair Series).

Therefore, it is concluded that the valley of Quitchupah Creek, upstream of the confluence with Christiansen Wash, is an AVF since it meets the geomorphic and water availability criteria for AVF designation. However, as indicated on Plate 8, this AVF has only one area which is actively flood irrigated with Quitchupah Creek water (i.e., Jack Lewis' field) and the balance of the valley is an AVF due to the potential for flood irrigation. Based on preliminary information, it should also be pointed out that the actively flood irrigated field of Jack Lewis appears to be significant to his farming operation.

<u>Quitchupah Creek below confluence with Christiansen Wash</u>. As shown on Plate 8, the geomorphic character of the Quitchupah Creek valley changes below the confluence with Christiansen Wash from a relatively broad valley to a very narrow, deeply incised valley which increases in width near the confluence with Ivie Creek. There is no evidence of

historical flood irrigation along this reach of Quitchupah Creek. With regard to the potential for flood irrigation in this area, Messrs. Moreau and Fish of the SCS indicated that the terrain is "too rough" and the valley "too narrow" for a viable flood irrigation activity and that there is no precedence in the region to flood irrigate similar valleys. Mr. Mortenson stated that this reach of Quitchupah Creek is not conducive to flood irrigation due to the rugged nature of the terrain (e.g., 150 foot ledges) and the fact that little room exists for a ditch. In addition, Mr. Mortenson stated that this part of the Quitchupah Creek valley is too thin and eroded to support a flood irrigation system.

Based on the absence of historical and existing flood irrigation along this reach of Quitchupah Creek and the statements given above with respect to the potential for flood irrigation, it is concluded the Quitchupah Creek valley from the confluence with Christiansen Wash down to the confluence with Ivie Creek does not qualify as an AVF.

Ivie Creek

As indicated on Plate 8, limited areas of unconsolidated streamlaid deposits occur along the valley of Ivie Creek from its headwater area to its confluence with Muddy Creek. No evidence exists of successful flood irrigation along any part of the Ivie Creek valley. According to Mr. Mortenson, a limited flood irrigation activity was practiced immediately upstream of Ivie Creek's confluence with Quitchupah Creek. However, for unknown reasons (perhaps a lack of water according to Mr. Mortenson), this activity was discontinued. Mr. Mortenson went on to state that the upstream area of Ivie Creek is "too high and rough with clay hills" to support flood irrigation. Mr. Mortenson said that he was not aware of any other examples in the region of flood irrigation agricultural activities occurring in valleys similar to the upstream area of Ivie Creek.

As shown on Plate 8, the valley of Ivie Creek broadens to a limited extent in the area of the confluence with Quitchupah Creek. The valley in this area is generally eroded and gullied. In addition, as discussed in previous submittals by Consolidation Coal Company, the water quality of Ivie Creek in this area is very limiting from an irrigation standpoint and is of substantially poorer quality than irrigation water from Muddy or Quitchupah Creeks. More specifically, at a station approximately 0.5 mile above Ivie Creek's confluence with Quitchupah Creek, water quality samples indicate that Ivie Creek exhibits a very high salinity hazard and a medium sodium hazard for irrigation purposes. (Furthermore, similar to other drainages in the area, it is expected that specific conductance and SAR will increase downstream.) In addition, the soils in the valley of Ivie Creek are strongly affected by alkali and have moderate salinity hazard. Therefore, given extant soil and water conditions, considerable water would have to be applied to achieve proper leaching; according to Messrs. Moreau and Fish, valleys similar to Ivie Creek in the region seldom have sufficient water to meet these leaching requirements in order to assure successful flood irrigation. Therefore, it is not regional practice to flood irrigate with waters similar in quality to those of Ivie Creek.

Based on lack of successful historical flood irrigation agricultural activities in the Ivie Creek valley; the rough terrain and marginal soils of upstream areas; the eroded and gullied landform, the poor water quality and soils, and limited water availability in the area downstream of the confluence with Quitchupah Creek; and the absence in the region of any precedence to irrigate valleys of similar characteristics and condition, it is concluded that there is no potential for flood irrigation agricultural activities in the valley of Ivie Creek. Therefore, it is determined that the valley of Ivie Creek is not an AVF.

Christiansen Wash

All flood irrigation which is currently taking place in the valley of Christiansen Wash is based on water from Muddy Creek which is supplied by the Emery Ditch. There is no historic precedence for the use of water from Christiansen Wash for irrigation purposes in the Christiansen Wash valley. According to Mr. Mortensen, the valley of Christiansen Wash is "much too incised and deep" to utilize water directly from the wash. The amount of ditching required to bring water to potentially irrigable fields would not be justified given the amount of water available from Christiansen Wash's 11 square mile drainage. Messrs.

Moreau, Fish, and Mortenson said they were not aware of any regional precedence to develop local flood irrigation systems for valleys with characteristics similar to those of Christiansen Wash. In addition, as indicated in previous water quality sampling, the water quality of Christiansen Wash indicates that its water has a very high salinity hazard and a medium sodium hazard for irrigation and is even of poorer quality than water from Ivie Creek. As a result, from the standpoint of potential flood irrigation agricultural activities, Christiansen Wash has very severe water quality limitations.

Therefore, it is concluded that since (1) no historical evidence exists for irrigation activities in the valley of Christiansen Wash with water from Christiansen Wash; (2) all irrigation to date has been dependent on waters from Muddy Creek; (3) the terrain of the Christiansen Wash valley is not conducive to flood irrigation with local waters; (4) severe water quality limitations exist with respect to flood irrigation with water from Christiansen Wash; and (5) no regional precedence exists for irrigating valleys of similar condition to Christiansen Wash, It is concluded that the valley of Christiansen Wash is not an AVF.

Appendix XI-3

Alluvial Valley Floor Investigation

Note: References in this document to Plate 8 should be changed to Plate 1, Appendix XI-1. Reference to Figure 1 should be changed to Plate XI-1. Reference to Chapters 7 and 12 should be changed to Chapters VI and V respectively.

ALLUVIAL VALLEY FLOOR INVESTIGATIONS

RESPONSE TO UTAH DIVISION OF OIL, GAS, AND MINING
LETTER DATED JANUARY 27, 1984

PREPARED BY
CONSOLIDATION COAL COMPANY
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March 1, 1984

PREFACE

This alluvial valley floor (AVF) investigations report replaces that dated February 23, 1984.

Much of this report was prepared by Kaman Tempo, a Division of Kaman Sciences Corp., 600 South Cherry Street, Denver, CO 80222.

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SECTION 1

INTRODUCTION

In its Preliminary Alluvial Valley Floor Determination, the Utah Division of Oil, Gas, and Mining (DOGM) made a preliminary positive AVF determination for all portions of Quitchupah Creek, and a preliminary negative AVF determination for Christiansen Wash. In upper Quitchupah Creek (above the confluence with Christiansen Wash), flood irrigation is currently practiced using waters diverted from Quitchupah Creek and from the Muddy Creek watershed. The lower reaches of Quitchupah Creek are not flood irrigated; however, insufficient information regarding regional flood irrigation practices was provided to assess the capability of lower Quitchupah Creek (below the confluence with Christiansen Wash) to be flood irrigated. Christiansen Wash crosses the irrigated lands which use water diverted from Muddy Creek. No water has historically been diverted directly from Christiansen Wash itself. Based upon rough estimates of the water availability in Christiansen Wash, the DOGM calculated that sufficient natural flow is available to flood irrigate approximately 11 acres. An area this size is probably too small to be agriculturally useful. However, the State reserved its final determination until additional information on regional flood irrigation practices could be provided.

In Fall, 1983, a report was prepared which described regional irrigation practices in Emery and Carbon Counties in central Utah. This report was submitted to the State for review in October, 1983. This report was based upon a field visit to the mine site, and upon interviews with Messrs. Gary Moreau and Bob Fish of the SCS in Price, and with Mr. Clyde Mortenson of the Muddy Creek Irrigation Company in Emery. These individuals are recognized experts with respect to regional irrigation practices in the area of the Emery Mine. The regional report concludes that Quitchupah Creek, below the confluence with Christiansen Wash, and Christiansen Wash are not Alluvial Valley Floors. There is no evidence of historical flood irrigation along the lower reaches of Quitchupah Creek. In addition, the valley is too narrow and the terrain too rough to support viable flood irrigation activities. There is no precedent in the region to flood irrigate similar valleys.

All flood irrigation which is currently occurring in the Christiansen Wash valley is based upon water from Muddy Creek which is supplied by the Emery Ditch. There is no historical use of water from Christiansen Wash for irrigation in the Christiansen Wash valley. The stream channel is "much too incised and deep" to utilize water directly from the wash. The amount of ditching required to deliver the water to potentially irrigable fields would not be justified given the amount of water available from Christiansen Wash's 13 square mile watershed. In addition, water quality in Christiansen Wash has a very high salinity hazard and a medium sodium hazard, and would, therefore, be unsuitable for flood irrigation. Finally, regional flood irrigation experts were not aware of any regional precedent to develop local flood irrigation systems in valleys with characteristics similar to those of Christiansen Wash.

This report serves two purposes. The first is to provide additional information concerning areas of potential alluvial valley floor located along upper Quitchupah Creek. The second purpose is to respond to specific questions from the DOGM with regard to water availability in Christiansen Wash and with regard to regional flood irrigation practices.

SECTION 2

QUITCHUPAH CREEK

2.1 AVF DETERMINATION

The upper Quitchupah Creek valley contains unconsolidated stream-laid deposits (Plate 8 of the permit application) and has sufficient water for flood irrigated agricultural activities as evidenced by on-going irrigation activities which utilize Quitchupah Creek water. An assessment of the annual runoff indicates that sufficient water could be available to flood irrigate 300 to 400 acres along the Quitchupah Creek valley. The initial alluvial valley floor investigations (Watec, Inc., 1980) did not identify any areas of subirrigation along the Quitchupah Creek valley.

Based upon this information (that relating to the application of AVF geomorphic and water-availability criteria) and that available from soil surveys, discrete areas of the upper Quitchupah Creek valley have been determined to be a potential alluvial valley floor. These areas of potential alluvial valley floor either presently support or have the capability of supporting, flood irrigated agricultural activities. The areas of potential alluvial valley floor along the upper Quitchupah Creek valley are shown on Figure 1. Appendix 1 contains soil and agricultural use information pertinent to the precise definition of the potential AVF areas.

2.2 ADDITIONAL FACTORS

Within the boundaries of the potential alluvial valley floor areas shown on Figure 1, several specific areas have been individually identified. Those areas of potential alluvial valley floor in Sections 29 and 32 (T22S, R6E) are eligible for exemption from certain alluvial valley floor provisions by reason of being associated with underground coal mining activities that, in the years preceding August 3, 1977, produced coal in commercial quantities and were located within or adjacent to alluvial valley floors. For these areas (Area I shown on Figure 1), demonstrations are not required that mining activities would not discontinue, interrupt, or preclude farming on the alluvial valley floor, or that mining operations would not materially damage the quantity and quality of water in surface and underground systems that supply the alluvial valley floor (i.e., these areas are grandfathered). However, mining operations in these areas must still comply with performance standards which include the requirement that the essential hydrologic functions of the alluvial valley floor be preserved during the mining and reclamation process. It should be noted that the actively flood-irrigated area north of Quitchupah Creek in Section 29 is irrigated by water supplied from Muddy Creek.

Portions of the areas of potential alluvial valley floor in Section 30 north of the Quitchupah Creek channel (Area II shown on Figure 1) are currently flood irrigated with water supplied from Muddy Creek and delivered by the Emery Ditch. These fields are not eligible for the exemption. As pointed out in previous submittals, these areas which are presently flood irrigated with waters diverted from Muddy Creek do not qualify as actively flood irrigated alluvial valley floors since this water is from another drainage basin. However, this area and areas in Sections 19 and 30 which are not currently irrigated but are capable of irrigation based on soil type, are underlain by unconsolidated stream-laid deposits which have the potential to be flood irrigated by water from Quitchupah Creek. As a result, these areas are a potential AVF because of their capability for flood irrigation. Mining operations affecting these areas must comply with the performance standard which requires that the essential hydrologic functions of the alluvial valley floor be preserved during the mining and reclamation process.

Only one portion of potential AVF area is actively flood irrigated with Quitchupah Creek water. This is Jack Lewis' field located to the south of the Quitchupah Creek channel. (This area is identified as Area III on Figure 1.) The portion of this field located in Section 29 is eligible for the exemption discussed above. However, the portion of the field located in Section 30 is not eligible for the exemption. For the non-exempt area (Area III), it is necessary to show that: 1) the proposed operations would not interrupt, discontinue, or preclude farming on the alluvial valley floor; and 2) the proposed operations would not materially damage the quantity and quality of water in surface and ground water systems that supply the alluvial valley floors. In addition, the performance standard requiring that the essential hydrologic functions be preserved during the mining and reclamation process also applies.

2.3 AVF FINDINGS

For the purpose of making the required alluvial valley floor findings, the upper Quitchupah Creek alluvial valley floor can be divided into two categories. All three of the alluvial valley floor findings must be made for the non-exempt portions of Jack Lewis' field (Area III). For the remainder of the alluvial valley floor (i.e., the exempted portions of Jack Lewis' field, the areas flood irrigated with water supplied from Muddy Creek, and areas of alluvial valley floor not currently developed for flood irrigation agricultural purposes) a finding that the essential hydrologic functions of the alluvial valley floor are preserved, must be made.

2.3.1 The Proposed Operations Would Not Interrupt, Discontinue, or Preclude Farming

The proposed mining and reclamation operations would not interrupt, discontinue, or preclude farming operations in the non-exempt portions of Jack Lewis' field. No surface disturbance would occur in this area. The proposed operation is an underground mining operation and the surface facilities associated with the mine are located at the confluence of Quitchupah Creek and Christiansen Wash, downstream from any areas identified as potential alluvial valley floors. Portions of Jack Lewis' field would be undermined by the proposed operation. As shown on Figure 1 a sub-main would be driven along the southern boundary of Jack Lewis' field. Access along the sub-main would be maintained by limiting the extraction of coal. As a result, no subsidence effects are expected in this area. During the 5-year permit term, no other mining activities would occur beneath this portion of the potential alluvial valley floor. In other portions of the permit area, coal would be extracted using partial pillar recovery methods. Subsidence could occur in these areas. However, a sufficient buffer would be maintained to avoid disturbing the non-exempt portions of Jack Lewis' field.

2.3.2 The Proposed Operations Would Not Materially Damage The Quantity And Quality Of Water Systems That Supply The Alluvial Valley Floor

The proposed operations would not materially damage the quantity and quality of water in surface and underground water systems that supply the non-exempt portions of Jack Lewis' field.

Quitchupah Creek is the partial source of water used for flood irrigation in Jack Lewis' field. This water is diverted from Quitchupah Creek upstream of the proposed permit area, and is brought to the irrigated fields by way of a diversion ditch (shown on Figure 1). This diversion flows along the south side of the Quitchupah Creek valley, and delivers water to Jack Lewis' field. The delivery ditch crosses an area of a mine panel where extraction will be limited to protect an occupied structure, and, as a result, no subsidence is expected to occur (see Chapter 12). Therefore, mining activities would not be expected to affect either the grade or the integrity of the delivery ditch.

Hydrologic effects of the proposed mining operations were identified in the DOGM's Draft Technical Analysis for the Emery Deep Mine. Two of the impacts identified in that analysis would affect the quantity and the quality of flow in Quitchupah Creek. These impacts are a potential decrease in ground water discharge through the subcrop of the upper Ferron aquifer to Quitchupah Creek and to Christiansen Wash, and a potential change in water quality as a result of the discharge of water from the underground workings to an ephemeral tributary of Quitchupah Creek. Both the subcrop area of the upper Ferron aquifer and the mine water discharge pond are located downstream from the point where water is diverted from Quitchupah Creek, and downstream from the non-exempt portion of Jack Lewis' field. As a result, neither the quantity nor the quality of water supplied to the field would be affected.

2.3.3 The Proposed Operations Would Preserve Throughout The Mining And Reclamation Process The Essential Hydrologic Functions Of Alluvial Valley Floors

Coal mining operations are required to preserve throughout the mining and reclamation process the essential hydrologic functions of alluvial valley floors. However, as stated in OSM's AVF Guidelines (U.S. Department of Interior, 1983, pIII-10), "the term 'preserve' is understood (based on legislative history) to have two meanings, depending on whether the alluvial valley floor is within or outside the affected area. For alluvial valley floors within the affected area, the term 'preserve' means that the essential hydrologic functions must be reestablished during reclamation." For alluvial valley floors outside of the affected area, the essential hydrologic functions must be maintained. The essential hydrologic functions of the non-exempt portions of Jack Lewis' field would be maintained throughout mining and reclamation. If the essential hydrologic functions in other areas of potential alluvial valley floor are affected by the proposed mining operations, they will be reestablished during reclamation.

The term, "essential hydrologic functions", refers to the hydrologic role of valleys in providing water that is usefully available for agricultural purposes. Broadly defined, this includes those geologic, topographic, hydrologic, and biological characteristics which make the valley agriculturally useful. In the case of the areas of potential alluvial valley floor in upper Quitchupah Creek, the essential hydrologic functions are those characteristics which make areas of the upper Quitchupah Creek valley suitable for flood irrigated agricultural activities. The essential hydrologic functions of the areas of the upper Quitchupah Creek valley which qualify as AVF include:

1. A geometry and physical character that are suitable for flood irrigation. The valley bottom is broad and flat. The valley fill deposits are not severely eroded, and the stream channel is not deeply incised;

2. The runoff characteristics of Quitchupah Creek are suitable for flood irrigation. Quitchupah Creek is a perennial stream which provides a sufficient quantity of water for flood irrigation. The water quality is suitable for flood irrigation; and

3. The soils associated with the valley fill material are, in part, suitable for flood irrigation as evidenced by ongoing flood irrigated agricultural activities.

In the non-exempt portions of Jack Lewis' field the essential hydrologic functions of the potential alluvial valley floor would be preserved throughout the mining and reclamation process. No surface disturbances are proposed in this area, and the valley bottom soils would not be disturbed. Coal extraction along the proposed sub-main would be limited, and no subsidence is expected in this area. Therefore, the geometry and physical character of the field would not be affected by the proposed mining operation and would continue to support flood irrigation. Additionally, as discussed above, the quantity and quality of the water which supplies irrigation water to the field would not be affected by the proposed operations.

If the essential hydrologic functions of the remaining areas of potential alluvial valley floor are affected by the proposed mining operation, they would be reestablished as a part of reclamation. However, it is not expected that the essential hydrologic functions would be affected. A subsidence buffer zone has been established along the course of Quitchupah Creek. As a result, the integrity of the stream channel would be maintained, and no changes in stream channel gradient are expected.

The Draft Technical Analysis identified two potential impacts to the quantity and quality of flow in Quitchupah Creek. A decrease in ground water discharge through the subcrop of the upper Ferron aquifer to Quitchupah Creek and Christiansen Wash would occur downstream of any area of potential alluvial valley floor. In addition, mine water is pumped from the underground workings and is discharged to an ephemeral tributary of Quitchupah Creek. This discharge is also located downstream from areas of potential alluvial valley floor.

Beneath areas of exempted alluvial valley floor and beneath portions of areas of potential AVF north of the stream channel, coal would be extracted using partial pillaring techniques. Although not anticipated, subsidence could occur in these areas. Experience in other portions of the permit area indicates that, should subsidence occur, it would manifest itself as small, circular, isolated, localized depressions.

In the areas of potential alluvial valley floor, maximum subsidence could range from 2 to 5 feet depending upon overburden thickness. (See subsidence projections in Chapter 12 of the permit application). These depressions could limit the agricultural use of affected areas. Areas of potential AVF which experience subsidence as a result of underground mining will be restored to a topography which is conducive to flood irrigation (cropland cases) and which exhibits a similar agricultural production rate to what occurred before disturbance.

Each particular subsidence site has it's own characteristics, thus reclamation of each area will be treated on a case by case basis. However, there are two basic reclamation options, which Consol will use depending on the particular circumstances of each site: (1) The cut and fill method. This method first involves removing the topsoils in the affected area and stockpiling them. Following topsoil removal, the surrounding topography is graded into the subsidence area and reshaped to fit the adjacent landform. The stockpiled topsoil is then respread to an even depth over the affected area. This method is the preferred method, and will be used on all rangeland areas and on all cropland areas which have a topography which lends itself to this method without disturbing an unnecessarily large amount of adjacent area. (2) The borrow site method. Cropland subsidence areas which have a surrounding topography that is too flat and thus would require disturbing an excess amount of adjacent land will be reclaimed by this method. These sites will be reclaimed by first removing the topsoil in the affected area and stockpiling it. Then, suitable fill material will be brought from an approved borrow site. After the fill dirt has been graded smooth, the stockpiled topsoil will be respread over the affected site.

After topsoiling in either optional case, the reclaimed sites will be ready to resume the same basic level of land use that was utilized prior to subsidence. Rangeland sites will be drill seeded with a native rangeland seed mix, while cropland areas will be seeded to whatever the predisturbance crop was.

2.3.4 AVF Monitoring

Consol has previously submitted a hydrologic monitoring plan and a subsidence monitoring plan. (These are included in Chapters 7 and 12 of the permit application, respectively.) Much of this monitoring would occur in or adjacent to areas of potential alluvial valley floor and would serve to demonstrate that the alluvial valley floor performance standards are being met. In addition, specific aspects of areas of potential alluvial valley floor would also be monitored.

In order to ensure that farming on the non-exempt portions of Jack Lewis' field is not interrupted, discontinued, or precluded, agricultural activities would be informally monitored by mine personnel. If any change in agricultural activities is observed, the operator will investigate the cause, and the Utah DOGM will be notified.

In order to ensure that the supply of water to the non-exempt portions of Jack Lewis' field is not materially damaged, the Quitchupah Creek irrigation ditch will be visually inspected before and during the growing season. This will ensure that the structural integrity and the grade of the ditch will not be adversely affected. In addition, the mine operator will maintain communication with the operator of the irrigated field in order to quickly identify suspected problems.

Finally, in order to demonstrate that the essential hydrologic functions are reestablished as a part of reclamation, the operator will conduct a topographic survey of potential AVF areas in the upper Quitchupah Creek valley bottom prior to bond release. This will ensure that the physical character (topography) of these areas are capable of supporting flood irrigated agriculture.

SECTION 3

CHRISTIANSEN WASH

In its January 27, 1984 letter, DOGM asked several specific questions concerning water availability in Christiansen Wash and regional flood irrigation practices in the Emery area. This section provides responses to those questions.

1. What is the mean annual flow and distribution in Christiansen Wash exclusive of the transferred water?

The flow characteristics of Christiansen Wash are greatly influenced by irrigation return flow from Muddy Creek irrigation water. Since hydrologic data was not collected prior to the agricultural use of water in Christiansen Wash, is is not possible to directly identify the natural flow conditions. However, the natural flow conditions can be estimated by abstracting the effects of return flow from the existing flow data.

The US Geological Survey maintains a gaging station on Christiansen Wash downstream from the area of flood irrigation. Mean monthly yields for Water Years 1979 - 1982 are provided in Table 1. (Data from Water Year 1983 was not used because they were considered to be anomalous.) The mean annual yield during this same period was 2103 acre-feet.

TABLE 1

CHRISTIANSEN WASH
MEAN MONTHLY YIELD
WATER YEARS 1979 TO 1982

Month	Mean Monthly Yield (Ac.-Ft.)
October	142
November	106
December	63
January	62
February	90
March	139
April	242
May	296
June	328
July	271
August	124
September	240
Mean Annual Yield	2,103

Approximately 60% of flow occurs during the growing season (May to September). In contrast, approximately 77% of the runoff in Muddy Creek occurs during the growing season.

The potential irrigation return flow in Christiansen Wash can be estimated from the acreage of flood irrigated fields located along Christiansen Wash. Approximately 2000 acres of the area identified as Quaternary Alluvium is flood irrigated along the Christiansen Wash valley. Based upon regional practices, water is applied to these fields at an annual rate of 4 acre-feet/acre. Therefore, approximately 8000 acre-ft. of water from the Muddy Creek drainage is applied to fields in Christiansen Wash each year.

The irrigated fields are used for irrigated pasture and for hayland. These crops would have an estimated consumptive use of 2.7 ft./year. (According to Table 14-2 (Linsley and Franzini, 1972), the consumptive use for alfalfa is 2.8 ft./year and for wild hay is 2.6 ft./year.). Therefore, approximately 5,400 acre-ft. of water would be consumed annually by the crops. This leaves approximately 2,600 acre-ft. of water that is delivered to the fields but is not consumed by the irrigated crops. Given the relatively flat topography of the fields, much of this excess would percolate downward beyond the root zone and would not be used by crops. Water percolating below the root zone would enter the stream/alluvial aquifer system, and would potentially become return flow in Christiansen Wash. This estimated percolation loss is 33 percent of the water delivered to the field. Linsley and Franzini (1972, p. 400) state that "the usual range of percolation loss is from 15 to 50 percent of the applied water." The value predicted here falls well within the expected range.

If all of the estimated percolation loss from irrigated fields located on alluvial deposits became return flow, the estimated return flow (2,600 ac. ft./year) would exceed the mean annual yield (2,103 ac.-ft./year) of Christiansen Wash at the US Geological Survey gaging station. This indicates that much, if not all, of the flow observed at the gaging station is the result of irrigation return flow. This conclusion is supported by the poor quality of water in Christiansen Wash (Watec, 1980), and by the observations of Mr. Clyde Mortenson of the Muddy Creek Irrigation Company. Mr. Mortenson states that (personal communication, 1984), Christiansen Wash, above the area of flood irrigation, flows only in the spring and in response to thunderstorms. During the rest of the year the stream is dry.

2. Could the water in Christiansen Wash be delivered to the irrigated alluvial lands by practices currently used in the region?

Water in Christiansen Wash could not be delivered to the irrigated lands by practices currently used in the region. The standard flood irrigation practice in Emery and Carbon Counties is to build storage reservoirs on the major perennial streams in the area and to develop widespread ditch systems to distribute stored irrigation waters. The natural flow regime in Christiansen Wash appears to be ephemeral, and according to Mr. Clyde Mortenson (personal communication, 1984), attempts to construct a reservoir on Christiansen Wash in 1929 were abandoned. (The reasons that the project was abandoned are not known.) In addition, as indicated in the assessment of regional flood irrigation practices submitted in October, 1983, the valley of Christiansen Wash is too incised and deep to utilize water directly from the wash. The amount of ditching required would not be justified given the limited amount of water available from the small watershed.

3. As a regional practice, how much water per acre is needed for agricultural use?

According to Mr. Rex Bunderson, supervisor, Agricultural Stabilization Conservation Service, Emery, Utah (personal communication, 1980), the amount of water which has historically been used for irrigation in the Emery area is approximately 4 acre-ft./acre.

4. Regionally, how many agricultural acres constitute a minimal economic unit?

According to Mr. Clyde Mortenson (personal communication, 1984), the size of farmsteads in the area ranges from a minimum of 40 acres up to 200 acres, or greater. As an example, Jack Lewis' contiguous farmstead consists of over 700 acres.

5. Would instream water be available to support farming if no transfer existed?

Sufficient water would not be available to support farming if no transfer of water from Muddy Creek existed. The observations of Mr. Clyde Mortenson indicate that the natural flow regime of Christiansen Wash is ephemeral. (See response to question 1 above.) As indicated in the assessment of regional flood irrigation practices, submitted October, 1983, the standard flood irrigation practice is to build storage reservoirs on major perennial streams in the area. This regional pattern indicates that ephemeral drainages do not provide sufficient water to support farming.

6. Is it a regional practice to pump water from stream channels, and are there any places where pumping occurs where stream channels are deeply incised??

According to Mr. Clyde Mortenson (personal communication, 1984) it is not the regional practice to pump water from the streams.

He was unaware of any area in the region where pumping occurred.

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APPENDIX 1

Soil and Agricultural Use Information
Pertinent to AVF Determination

Soils which occupy the area along the upper Quitchupah Creek valley in which Quaternary alluvium was mapped on Plate 1 of Appendix XI-1 include the following:

Alluvial/Gullied Land (AW/GU)
* Beebe loamy fine sand, 1 to 3% slopes (BeB)
* Billings silty clay loam, 1 to 3% slopes (B1B)
* Billings silty clay loam, 1 to 6% slopes, eroded (B1C2)
Chipeta-Badland Association, 3 to 30% slopes, eroded (CBE2)
Chipeta-Persayo complex, 1 to 8% slopes, eroded (CPB2)
* Hunting clay loam, 0 to 5% slopes (Hn)
* Hunting clay loam, 1 to 3% slopes (Hs)
* Killpack loam, 1 to 3% slopes (KpB)
* Killpack loam, 3 to 6% slopes, eroded (KpC2)
Persayo-Chipeta complex, 1 to 20% slopes, eroded (PCE2)
* Penoyer loam, 1 to 3% slopes (PeB)
* Penoyer loam, 3 to 6% slopes, eroded (PeC2)
Rafael silty clay loam, 1 to 3% slopes (Ra)
* Ravola loam, 1 to 3% slopes (R1B)
Ravola-Bunderson complex, 1 to 3% slopes, eroded (RuB2)
Saltair silty clay loam, 0 to 3% slopes (Sa)
Shale outcrop (Sn)

These soils are shown on Plate 2 of Appendix XI-1 and soils series and map unit descriptions are presented for them in Chapter VII.

Those map units marked with an asterisk are capable of and are recommended for irrigation by the Soil Conservation Service (1970). Those unmarked are either not suited or are poorly suited to irrigation as noted by the SCS (1970). All of the unmarked map units are in capability Class VII - Soils having very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife. Most of these Class VII soils are limited by erosion, however, the Rafael soil is limited by wetness and land of the shale outcrop unit is limited by soil that is shallow, droughty, or stoney. For these reasons, the above unmarked soil and map units were excluded from classification as areas of potential AVF.