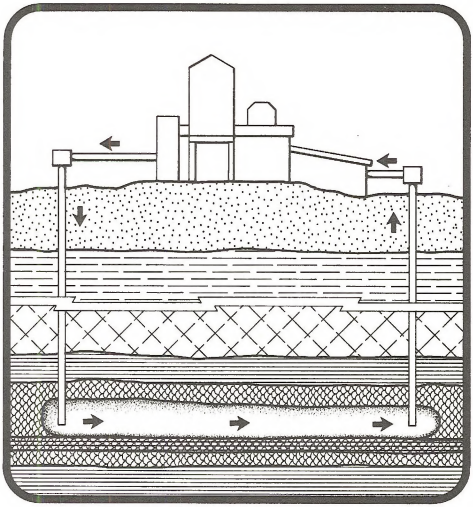
FINAL
ENVIRONMENTAL IMPACT STATEMENT

WOLF RIDGE CORPORATION
MINE PLAN
FOR A
NAHCOLITE SOLUTION MINE



U.S. Department of the Interior
Bureau of Land Management
White River Resource Area
Craig District, Colorado

July 1987

IN REPLY REFER TO:

United States Department of the Interior

1792/3500 (162)

BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE
2850 YOUNGFIELD STREET
LAKEWOOD, COLORADO 80215

June 17, 1987

Dear Reader:

This is the abbreviated Final Environmental Impact Statement (EIS) on the Wolf Ridge Corporation (WRC) Mine Plan for a Nahcolite Solution Mine. The draft EIS was distributed to the public in July 1986. This abbreviated final and the draft EIS constitute the complete final EIS. Both documents must be used in conjunction.

This EIS has been prepared pursuant to Section 102 of the National Environmental Policy Act of 1969, and federal regulations at 43 FR 3570. It describes and analyzes the environmental and socioeconomic impacts of WRC's mine plan, in addition to three other alternatives. It also identifies mitigative measures and stipulations that will be incorporated into the approved plan to 1) alleviate or minimize potential environmental impacts from their proposal, and 2) ensure compliance of their proposal with existing sodium lease terms.

The final EIS is not the BLM's decision on WRC's mine plan. The decision on the plan will be based on the analysis in the final EIS, public concerns and comments, and other multiple-use objectives or programs applicable to WRC's proposed project. No action can be taken for at least 30 days following filing of the final EIS with the Environmental Protection Agency and distribution to the public. A Record of Decision that outlines the decision and rationale for the decision will be prepared and made available to the public.

Thank you for your interest in this EIS.

Sincerely,

Neil F. Morck
State Director

FINAL
ENVIRONMENTAL IMPACT STATEMENT
for the
WOLF RIDGE CORPORATION MINE PLAN FOR A NAHCOLITE SOLUTION MINE

U.S. Department of the Interior
Bureau of Land Management
White River Resource Area
Craig District, Colorado

State Director
Colorado State Office

WOLF RIDGE CORPORATION
MINE PLAN FOR A
NAHCOLITE SOLUTION MINE
ENVIRONMENTAL IMPACT STATEMENT

Draft ( ) Final (X)

The United States Department of the Interior, Bureau of Land Management

1. Type of Action: Administrative (X) Legislative ( )

2. Abstract: This final environmental impact statement analyzes and defines the potential environmental and socioeconomic effects of Wolf Ridge Corporation's mine plan for a 30-year, 125,000 tons per year (tpy) nahcolite solution mine on existing leases they hold in the Piceance Basin, Rio Blanco County, Colorado. In addition, this EIS identifies mitigative measures and special stipulations that will be incorporated into the approved plan. Three other alternatives are also analyzed: a 50,000 TPY Alternative, a 500,000 TPY Alternative, and a No Action Alternative.

3. For further information, contact:

Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
PO Box 928
Meeker, Colorado 81641
Telephone (303) 878-3601

4. Date Statement made available to EPA and to the public:

Draft - July 25, 1986
Final - July 31, 1987

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FEDERAL AGENCIES

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    Bureau of Indian Affairs
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    Bureau of Reclamation
    Fish and Wildlife Service
    Geological Survey
    Minerals Management Service
    National Park Service
    Western Area Power Administration
Environmental Protection Agency
Nuclear Regulatory Commission

STATE AGENCIES

Colorado Department of Health
Colorado Department of Highways
Colorado Department of Natural Resources
Colorado State Clearinghouse
Colorado State Historic Preservation Office
Colorado Water Conservation Board

LOCAL AGENCIES

Associated Governments of Northwest Colorado
City of Rifle
Garfield County
Rio Blanco County
Town of Meeker
Town of Rangely

OTHER ORGANIZATIONS AND INDIVIDUALS

Over 200 organizations and individuals have also expressed interest in the environmental impact statement and have been sent copies for review and comment.

PREFACE

INTRODUCTION

This is an abbreviated Final Environmental Impact Statement (EIS) on the Wolf Ridge Corporation (WRC) Mine Plan for a Nahcolite Solution Mine. The draft EIS was printed and distributed in July 1986. This abbreviated final contains a summary of the alternatives analyzed in the draft EIS, the major issues involved in the analysis, and an impact summary table (Section 1), a record of the public comments received on the draft EIS (Section 2.1), responses to those comments (Section 2.2), text changes to the draft EIS resulting from public comment and internal review (Section 3), and several appendices (Section 4).

This abbreviated final and the draft EIS constitute the complete final EIS. Both documents must be used in conjunction.

DIFFERENCES BETWEEN THE DRAFT AND FINAL

Public comments on the draft EIS did not, for the most part, require extensive changes in the data, analyses, or conclusions. Therefore, the bulk of the draft EIS has not been reprinted, but has been incorporated by reference into this abbreviated final. In addition to the Summary section, select sections have been reprinted in entirety within Section 3 for clarity. These include the Water Resources and the Aquatic, Wetland, and Riparian Habitats (renamed Wetland Habitats) sections. In the case of these sections, the analyses were expanded to include additional information as the result of internal review and/or in response to questions/comments raised by the public. Other sections reprinted in entirety are the Impact Summary Table (Table 2-2 at the end of Section 1) and Section 4.3, BLM Proposed Mitigation (Appendix C).

Changes worthy of note between the draft and final are:

1. Refinement and expansion of the Water Resources section. Because of numerous comments and the technical uncertainties involving hydrology issues (i.e., existing environment, impacts mitigation, monitoring), the analysis was carefully scrutinized, refined, and restated. However, the nature and anticipated degree of impact to the water resources is unchanged.
2. Reanalysis and rewrite of the Aquatic, Wetland, and Riparian Habitats section (renamed Wetland Habitats). As a result of field investigations, more wetland habitat was identified (approximately 126.5 acres exists) on Yellow Creek than was addressed in the draft EIS. The substance of the impacts described in the draft EIS also apply to these recently identified acres.
3. As a result of WRC's protest of two stipulations contained in the Bureau of Land Management's (BLM) approval of their pilot-scale project mine plan, a compromise was reached allowing WRC to demonstrate their proposed well completion technique. This compromise changed two of the No Action Alternative (pilot-scale project) stipulations contained on page 2-13 of the draft. It also required WRC to submit a monitoring plan for the pilot-scale project that addresses BLM concerns over their mud-gel completion technique. These changes are contained in Appendix A. No change in the nature or degree of the impacts identified in the draft is anticipated as a result of this change.
4. Inclusion of BLM's technical evaluation of WRC's proposed well completion and abandonment procedures (Appendix B).

1. SUMMARY

1. SUMMARY

1.1 Introduction

On October 9, 1984, Wolf Ridge Corporation (WRC), the holder of four federal sodium lease tracts within the Piceance Basin in northwest Colorado, submitted a mine plan to the Bureau of Land Management (BLM) for a commercial-scale nahcolite solution mine. Initial screening of the mine plan indicated that it represented a major federal action with the potential for significant impacts; therefore, pursuant to Section 102 of the National Environmental Policy Act of 1969 (NEPA), BLM determined that an environmental impact statement (EIS) would be required in conjunction with approval of the mine plan.

Four alternatives, including WRC's proposal, were described and analyzed in a draft EIS. The draft EIS analyzed and defined the potential environmental and socioeconomic effects of each of these alternatives. In addition, the draft EIS identified necessary mitigation in the form of stipulations that would be incorporated into the approved plan. Following a 60-day public comment period, this final EIS was developed, based upon consideration of public comments and an internal review of the draft EIS. This final EIS, which is an abbreviated final, incorporates by reference most of the draft EIS; therefore, the final EIS must be used in conjunction with the draft EIS.

1.2 Alternatives Analyzed

The following narrative briefly describes each of the alternatives and summarizes their anticipated impacts.

1.2.1 No Action Alternative

This alternative involves construction and operation of a 6-ton per hour (tph), 2-year maximum pilot-scale nahcolite mine that was analyzed by BLM in an environmental assessment (EA Number CO-010-86-07) and approved in a decision record signed May 2, 1986, and subsequently amended on September 10, 1986 (Appendix A). Therefore, this action (the pilot-scale mine) is independent of WRC's commercial-scale mine plan and can occur, regardless of the decision resulting from this EIS analysis. The pilot project represents the continuation of current management practices in the study area. Thus, under the No Action Alternative, the approved pilot project will take place; however, expansion of the approved pilot project to a commercial-scale will not occur.

Facilities approved for the pilot project include: a 5-acre plant site, a 4-acre well field for in situ solution mining of nahcolite, an evaporation pond encompassing 4 acres, a new water well and ancillary pipeline, and upgrading (including graveling) of the existing access road into the plant site.

No significant impacts will result from the No Action (Pilot Project) Alternative. Minor short-term impacts will occur to air quality, soils, vegetation, livestock grazing, water resources, wildlife, and recreational/visual resources. Cultural and paleontological resources will also be potentially impacted. Existing and future mineral lease rights could be complicated because of diminished surface occupancy possibilities within the project development area.

Groundwater consumed by the pilot project will incrementally contribute to the cumulative adverse alterations of downstream endangered fish habitat, although the project, by itself, will not jeopardize the continued existence of any listed fish. Mitigation (conservation measures) will be employed to compensate for any impact resulting from the pilot project.

1.2.2 Proposed Action (Preferred Alternative)

WRC's proposal involves construction and operation of a commercial-scale nahcolite solution mine to produce sodium bicarbonate at a maximum rate of 125,000 tons per year (tpy) over a 30-year period. The proposal involves phased-approach development, with initial production of 50,000 tpy, increasing in the second or third year of operation to 125,000 tpy.

The Proposed Action would involve: expansion of the approved pilot project well field and plant site, including paving of the access road into the plant site (all affecting up to 215 additional acres), construction of additional evaporation ponds (affecting up to 22 additional acres), construction of a natural gas pipeline into the plant site (involving 17 acres), and addition of a warehouse/rail loading facility at Lacy Station in Rifle, Colorado.

The only potentially significant impacts associated with this alternative would be to local groundwater quantity and quality. There would be a 3.2 percent reduction in average daily flow from Yellow Creek. This would be mitigated through a state required water augmentation plan. The area

of the base of the lower aquifer in contact with saline minerals would increase by approximately 20 percent within the lease tracts.

The resources described as being affected under the No Action Alternative, in most cases, would be impacted to a greater degree under this alternative because of the longer (30-year) project life. In addition, mined out cavities and potential subsidence could complicate future oil and gas drilling within the sodium well field. Potential surface subsidence of less than 1 foot would also occur. However, none of these impacts would be significant if the identified mitigation measures are employed (Appendix C).

1.2.3 50,000 TPY Alternative

This alternative would involve construction and operation of a 30-year solution mine producing 50,000 tpy of sodium bicarbonate. It would essentially be an expansion of the 2-year pilot project to a 30-year commercial facility. It would involve similar, but less expansion than described under the Proposed Action, except the access road would not be paved and the Lacy Station warehouse/rail loading facility would not be built. Approximately 90 acres of additional land would be associated with expansion of the well field. Additional evaporation ponds would be required, affecting approximately 10 acres.

The only potentially significant impacts associated with this alternative would be to local groundwater quantity and quality. There would be a 2.0 percent reduction in average daily flow from Yellow Creek. This would be mitigated through a state required water augmentation plan. The base of the lower aquifer, in contact with saline minerals, would increase by approximately 10 percent within the lease tracts. Other resource impacts would be similar, although greater than those addressed under the No Action Alternative, because of the 30-year project life. Potential surface subsidence of less than 1 foot would also occur under this alternative.

1.2.4 500,000 TPY Alternative

This alternative would involve construction and operation of a 30-year solution mine producing 500,000 tpy of sodium bicarbonate. It would involve: substantial expansion of the approved pilot project well field and plant site (affecting up to 818 additional acres), additional evaporation ponds (affecting up to 88 additional acres), a commercial transmission power line into the plant site, bulk product loading and handling facilities on-site and at Lacy Station, and a coal-fired generator and associated facilities.

Impacts to all resources would be greatest under this alternative. Potentially significant impacts would occur to air quality, groundwater quantity and quality, cultural resources, and riparian-wetland habitat along Yellow Creek.

The environmentally preferred alternative is the No Action Alternative. BLM's preferred alternative is the Proposed Action.

1.3 Major Issues/Controversies

The draft EIS lists a number of major issues that were identified as the result of the scoping process (Section 1.4, page 1-2). A number of these issues have received additional scrutiny as the result of an appeal by WRC of two stipulations contained in BLM's May 2, 1986, approval of their pilot-scale project (Phase II) mine plan. These stipulations, which were developed by BLM primarily through analysis of the pilot project in an environmental assessment (EA No. CO-017-86-07), were applied to minimize and/or alleviate potential environmental impacts related to WRC's proposed well completion and abandonment procedures. The two contested stipulations, which are found in the draft EIS, page 2-13, Section 2.3.1.7.3, read as follows:

1. The annulus between the well bore and the 8 5/8-inch well casing will be filled with cement from the bottom of the hole to the top of the A-groove.
2. A "Notice of Intent to Abandon" will be submitted by the designated operator/lessee to the authorized officer prior to abandonment of any well developed within this project. The notice will contain an "as-built" diagram of the well and will describe any changes from the approved abandonment/plugging procedures. The authorized officer will review and approve or approve with modifications the notice within 15 calendar days of receipt. No special form for this notice is required. As a minimum, the following plugs will be required: (1) a steel bridge plug will be placed at the base of the production casing; (2) 50 feet of cement will be placed above this plug; (3) a cement plug will be placed 50 feet below the Mahogany Zone through to 50 feet above the production casing stub; and (4) 65 feet of the cement will be placed at the surface. The intervals between the cement plugs will be filled with 9 pound/gallon or heavier drilling mud. Other cement plugs may be required, based on analysis of the cement bond logs and the temperature survey log.

WRC appealed these two stipulations, arguing they were unreasonable and unwarranted given the nature and degree of impact anticipated from the pilot project. The major points raised in the appeal were:

1. The pilot-scale project is an experimental demonstration project to define and prove the technical and economic feasibility of nahcolite solution mining. Techniques and methodologies, such as their proposed well completion and abandonment procedures, need to be allowed by BLM so that the best, most cost effective operational procedures can be proven.
2. The upper and lower aquifers are hydraulically connected in the central Piceance Basin and are, in reality, one aquifer; therefore, there is no reason to isolate them.
3. Their proposed well completion and abandonment procedures are technically proven and will provide adequate protection to resources of concern (i.e., groundwater and oil shale). BLM's well completion stipulation is too costly.

BLM has never disagreed with or misunderstood the experimental intent and demonstrative purpose of WRC's pilot-scale project. However, the terms of the sodium leases held by WRC are very explicit in regard to protection of groundwater and oil shale resources, regardless of the type or purpose of development. The environmental impact analysis on the pilot-scale project, just as our analysis on the commercial-scale nahcolite project, was structured and constrained by these lease requirements (See draft EIS, Appendix E, Sections 2(l), (q); 5(a), (b), (c); and Stipulation No. 12).

In regard to the "one versus two" aquifers issue, BLM acknowledges that site-specific evidence seems to indicate that the upper and lower aquifers are hydraulically connected; however, we are not ready to accept matter-of-factly that they are in communication to the extent that they can be considered as a single aquifer. The extent and degree of communication has not yet been qualified or quantified. Therefore, in the absence of more definitive data, prudent management by BLM must be exercised in light of the explicit lease requirements addressing protection of the groundwater resources.

BLM had, and continues to have several technical and environmental concerns related to WRC's proposed well completion and abandonment methods. These concerns have focused upon the specific intent of the explicit lease terms requiring protection of groundwater and oil shale resources. These concerns are detailed in the Water Resources rewrite (Section 3, TEXT CHANGES) and in BLM's technical evaluation (Appendix B).

Pursuant to federal regulations 40 CFR Parts 144 to 147 (as promulgated from the Safe Drinking Water Act), the United States Environmental Protection Agency (EPA) has authority and responsibility to ensure protection of underground sources of drinking water for activities involving the injection of fluids into the ground. EPA is currently analyzing an application for a Class III - Underground Injection Control (UIC) permit on WRC's commercial nahcolite project (the Proposed Action). EPA has many of the same technical and environmental concerns expressed by BLM in this document. It's expected EPA will have a draft UIC permit completed by August 1987.

1.4 Summary of Impacts

The following table (Table 2-2) summarizes the potential impacts, by resource, for each of the alternatives as described in the Environmental Consequences section of the draft EIS and the Text Changes section of this document. Impacts which are considered significant are duly noted.

TABLE 2-2
SUMMARY OF IMPACTS

Resource	No Action (Pilot Plant)	Proposed Action/125,000 TPY	50,000 TPY	500,000 TPY
Air Quality	Small amount of local degradation for pollutants (primarily particulates, CO, SO_2, and NO_2) for 2-year maximum project life.	Same, except for 30 years.	Same, except for 30 years.	Potentially significant degradation from particulate emissions for 30 years—exceedance of Class II PSD increments.
	No affect to Class I/Category I AQRVs.	Same	Same	Potential adverse impact to Class I/Category I AQRVs from acid (nitrate and sulfate) deposition.
Topography	No impact	Potential surface subsidence of less than 1 foot.	Same as Proposed Action.	Same as Proposed Action.
Rock Quality	Strata immediately overlying the cavities significantly reduced. Mahogany Zone not significantly affected.	Same	Same	Same
Fluid Minerals	No affect to oil and gas resource. Future development of surface facilities would be complicated.	Same. In addition, mined-out cavities and potential subsidence could complicate future oil and gas drilling within the well field.	Same	Same
Solid Minerals	No significant adverse impacts expected to overlying oil shale resources.	Same	Same	Same
	Sodium resources within the affected area of the L-5E Bed potentially impacted should collapse of cavity roofs or pillar failure occur.	Same	Same	Same
	Sodium resources mined would be consumed; remaining sodium resources potentially foregone as pillars for subsidence control.	Same	Same	Same

TABLE 2-2 (continued)
SUMMARY OF IMPACTS

Resource	No Action (Pilot Plant)	Proposed Action/125,000 TPY	50,000 TPY	500,000 TPY
Water Resources				
Water Quantity/ Water Rights	No measurable reduction of stream flow.	About 3.2% reduction in average daily flow from Yellow Creek. .3% reduction from Piceance Creek. Any depletion is considered significant because of over allocation of surface water in the Piceance Basin.	About 2% reduction in average daily flow from Yellow Creek. .1% reduction from Piceance Creek. Considered significant.	About 15.3% reduction in average daily flow from Yellow Creek. 1.9% reduction from Piceance Creek. Considered significant.
Water Quality	No Significant Impact	Approximately 20% increase in the area of the base of the groundwater system in contact with saline minerals within the lease tracts. This is a 1% increase in the total area of the aquifer system in contact with saline minerals in the Piceance Basin. This is a locally significant impact and could be regionally significant.	Approximately 10% increase in the area of the base of the groundwater system in contact with saline minerals within the lease tracts. This is a 0.5% increase in the total area of the aquifer system in contact with saline minerals in the Piceance Basin. This is a locally significant impact.	Approximately 80% increase in the area of the base of the groundwater system in contact with saline minerals within the lease tracts. This is a 4% increase in the total area of the aquifer system in contact with saline minerals in the Piceance Basin. This is a locally significant and could be regionally significant impact.
Soils	Undeterminable loss of soil from wind and water erosion on disturbed areas.	Same	Same	Same
	Alteration of natural soil horizons; decrease in diversity of soil communities as a result of disturbance on up to 43 acres.	Same on up to 257 acres	Same on up to 118 acres	Same on up to 960 acres
Vegetation	Natural vegetative communities lost to surface disturbance on up to 43 acres.	Same on up to 257 acres	Same on up to 118 acres	Same on up to 960 acres
	Reclamation effort expected to return disturbed areas to production levels equal to or greater than predisturbance.	Same	Same	Same
	Remnant Vegetation Association (RVA) not affected.	78% of RVA destroyed	Same as Proposed Action	89% of the RVA destroyed

TABLE 2-2 (continued)
SUMMARY OF IMPACTS

Resource	No Action (Pilot Plant)	Proposed Action/125,000 TPY	50,000 TPY	500,000 TPY
Livestock Grazing	Forage production lost on disturbed areas resulting in a loss during the project life of 3-6 AUMs.	4 AUMs lost for project life.	2 AUMs lost for project life.	10 AUMs lost for project life.
Wildlife	Average 59-acre loss of mule deer winter range habitat at any given time over mine life—reucing Piceance Basin's carrying capacity threshold tolerance by 0.5 percent (see text).	Average 173-acre loss over mine life. Carrying capacity reduction of 1.3 percent.	Average 132-acre loss over mine life. Carrying capacity reduction of 1 percent.	Average 345-acre loss over mine life. Carrying capacity reduction of 2.6 percent.
	Long-term conversion of 4.5 acres of mature pinyon-juniper woodland habitat to shrub-grass character, with wildlife populations and community composition adjusting commensurate with remaining habitat.	Long-term conversion of from 54 to 127 woodland acres.	Long-term conversion of from 28 to 61 woodland acres.	Long-term conversion of from 186 to 406 woodland acres.
	Water consumption level of 93 acre-feet per year from Upper Colorado River Basin, ultimately reducing flow contributed to downstream endangered species fisheries.	Water consumption rate of 169 acre-feet per year.	Water consumption rate of 124 acre-feet per year.	Water consumption rate of 674 acre-feet per year.
	Riparian-wetland resources in Yellow Creek would remain unaffected.	No net loss of wetland acreage expected. Minor changes in emergent wetland composition considered functionally insignificant.	No net loss of wetland acreage expected. Minor change in emergent wetland composition considered functionally insignificant.	Substantial base flow loss has potential to effect notable reductions of in-channel wetland extent as well as considerable compositional shifts. Unable to quantify changes without additional hydrologic analysis.
Cultural Resources	4 known sites potentially impacted.	10 known sites potentially impacted.	7 known sites potentially impacted.	21 known sites potentially impacted.
	Potential destruction or loss of unknown sites from inadvertent disturbance due to construction, vandalism, or change in livestock grazing patterns.	Same	Same	Same

TABLE 2-2 (continued)
SUMMARY OF IMPACTS

Resource	No Action (Pilot Plant)	Proposed Action/125,000 TPY	50,000 TPY	500,000 TPY
Paleontological Resources	No known sites impacted. Potential destruction or loss of unknown sites from inadvertent disturbance due to construction or vandalism.	3 known sites impacted.	No known sites impacted.	3 known sites impacted.
Lands and Realty	Potentially complicates the development of existing oil and gas leases and future oil shale leases through diminished surface occupancy possibilities for 2-year maximum project life. Ancillary facility right-of-ways would establish undesignated utility corridors encouraging future utility right-of-way proposals.	May adversely influence development for 30 years. Same	Same as Proposed Action. Same	Same as Proposed Action. Same
Recreation	Area would shift from semiprimitive motorized to rural recreation opportunity spectrum on 43 acres.	Same on 257 acres	Same on 118 acres	Same on 960 acres
Visual	Visual qualities would remain Class IV.	Same	Same	Same
Social	Less than 1% population increase annually.	Same	Same	Same
Energy requirements (Btus x 10^{10}) per year/project life	19.58/39.16	43.84/1,315.00	17.52/525.60	119.40/3,582.00
Total acreage potentially disturbed over mine life	Up to 43	Up to 257	Up to 118	Up to 960

2. PUBLIC COMMENTS ON THE DRAFT EIS AND RESPONSES TO COMMENTS

2. PUBLIC COMMENTS ON THE DRAFT EIS AND RESPONSES TO COMMENTS

This chapter of the final EIS contains a copy of all written comments received on the draft EIS and oral testimony presented at the Grand Junction public hearing (Section 2.1), and responses to those comments (Section 2.2). The public comment period extended for 60 days, beginning July 25, 1986 and ending September 23, 1986. Public hearings were held in Meeker, Colorado, on August 26, 1986, and Grand Junction, Colorado, on August 27, 1986.

2.1 Public Comments

2.1.1 Introduction

The public comment letters submitted on the draft EIS appear in the order they were received by the White River Resource Area Office. To reduce the total volume of reprinted materials in this text, extensive attachments to some comment letters, that do not raise specific issues, have not been included. Following the letters is the transcript from the public hearing in Grand Junction. No substantive comments, that raised specific issues, were received from the public at the Meeker public hearing; therefore, the transcript was not included in this document. The transcript for the Meeker public hearing is available for public review at the BLM White River Resource Area office in Meeker, Colorado.

For ease of reference, the comment letters and the Grand Junction public hearing transcript have been listed in Table 2-1, according to source. The letter number or transcript number refers to the designation in the upper left hand corner of each letter or transcript.

Over 200 individual comments, taken from 16 individual letters and the Grand Junction public hearing transcript, were received on the draft EIS. Section 2.2 of this chapter contains a detailed response to each comment. The bulk of the comments involved geohydrologic concerns.

2.1.2 List of Comment Letters/Transcript

TABLE 2-1
COMMENT LETTERS/TRANSCRIPT
RECEIVED ON THE DRAFT EIS

Commenter	Letter Number
FEDERAL AGENCIES	
U.S. Department of Agriculture	
Forest Service-Rocky Mountain Region	16
U.S. Department of the Interior	
Bureau of Mines	3
Bureau of Reclamation	
Upper Colorado Regional Office	4
Engineering and Research Center	7
Geological Survey	12
Geological Survey-Office of Energy & Marine Geology	10
National Park Service	9
U.S. Fish and Wildlife Service	14
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STATE AGENCIES	
Colorado Historical Society	15
Department of Health-Air Quality Control Division	5
Department of Natural Resources-Division of Wildlife	5
INDIVIDUALS AND PROFESSIONAL CONSULTANTS	
Daub & Associates	11
Donald R. Johnson	8
Joan L. Savage	2
John W. Savage, Jr.	1
Wright Water Engineers, Inc.	6
PUBLIC HEARINGS	
Grand Junction, Colorado	A
Bill Bellis, Wright Water Engineers for Wolf Ridge Corp.	A
Jerry Daub, Daub & Associates for Wolf Ridge Corp.	A
Martin Jones, Cliffs Engineering Inc. for Wolf Ridge Corp.	A

2.1.3 Comment Letters/Transcript

1

JOHN W. SAVAGE, JR.
ATTORNEY AT LAW
P.O. BOX 1626 • RIFLE, COLORADO 81650-1626 • (303) 625-1470, 625-1365

July 29, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P. O. Box 928
Meeker, CO 81641

Re: Draft EIS - Wolf Ridge
Corporation - Nahcolite
Solution Mine

Dear Mr. Frank:

I have reviewed the Draft EIS for the above-referenced project and urge adoption of the Proposed Action.

2.3

The sodium minerals in the Piceance Basin were an important discovery and should be developed. As indicated in the EIS, development of the sodium minerals will have negligible impact on the oil shale or conventional oil and gas resource.

Rio Blanco and Garfield Counties have the infrastructure in place to accomodate the growth. The local economies have been hit hard by slumps in the oil shale, oil and gas, coal, uranium, and agricultural industries.

I urge acceptance of the proposed alternative.

Very truly yours,

John W. Savage, Jr.

JWS:trl

cc Joan L. Savage
Ed Rosar

2

SHALE INC.
1122 - 293 ROAD / RIFLE, COLORADO 81650 / 303-625-3149

Joan L. Savage
President

August 7, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P. O. Box 928
Meeker, CO 81641

Re: Draft EIS - Wolf Ridge
Corporation - Nahcolite
Solution Mine

Dear Mr. Frank:

Because of the possible importance of the use of Nacholite to mitigate negative environmental problems, I strongly support the alternative for 500,000 TPY.

Very truly yours,

Joan L. Savage

JLS:trl

3

United States Department of the Interior

BUREAU OF MINES

P. O. BOX 25086
BUILDING 20, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

Intermountain Field Operations Center

August 22, 1986

Your reference:
1792 (162)
3500

Memorandum

To: Willy Frank, Project Coordinator, Bureau of Land Management, White River Resource Area, PO Box 928, Meeker, Colorado 81641

From: Chief, Intermountain Field Operations Center

Subject: Review of draft environmental impact statement for Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine

24

Bureau of Mines personnel have reviewed the subject document, as requested by the BLM Colorado State Director, to determine if mineral-related impacts have been adequately considered.

In the project area, sodium minerals are known to be closely associated with oil shale and aluminum resources; coal, petroleum, and natural gas occur in underlying rocks. Other resources that may be present include sand and gravel and stone. All are adequately described in the DEIS (sec. 3.3).

We believe the environmental analysis for this project includes an adequate discussion of impacts on mineral resources. Possible conflicts that may occur between sodium development and recovery of other minerals are described in the DEIS (sec. 4.3). We have no objection to the document as written.

William Cochran

4

United States Department of the Interior

BUREAU OF RECLAMATION
UPPER COLORADO REGIONAL OFFICE
P.O. BOX 11568
SALT LAKE CITY, UTAH 84147

IN REPLY
REFER TO: GJ-150/UC-151

SEP 2 1986

Memorandum

To: Mr. Willy Frank, Project Coordinator, Bureau of Land Management, White River Resource Area, P.O. Box 928, Meeker, Colorado 81641

From: Acting Regional Director
Bureau of Reclamation

Subject: Review of Draft Environmental Impact Statement for the Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine (DES 86-31)

As requested, we have reviewed the subject document and have concluded that the proposed action will not adversely affect any of Reclamation's interests in western Colorado. Thank you for the opportunity to review this document.

5

STATE OF COLORADO

Department of Local Affairs

DIVISION OF LOCAL GOVERNMENT
Pat Raildi, Director

Richard D. Lamm
Governor

September 19, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P. O. Box 928
Meeker, Colorado 81641

SUBJECT: Wolf Ridge Corporation Mine Plan
for a Nahcolite Solution Mine
Draft Environmental Impact Statement

2-5

Dear Mr. Frank:

The Colorado State Clearinghouse has received the above-referenced Draft Environmental Impact Statement and has distributed it to interested state agencies. Comments received from the Colorado Division of Wildlife and the Air Quality Control Division/Department of Health are enclosed for your information.

Thank you for the opportunity to review this matter.

Sincerely,

Val Tungseth

Val Tungseth, Staff Assistant
Colorado State Clearinghouse

vt
Enclosures (2)

1313 Sherman Street, Room 520, Denver, Colorado 80203 (303) 866-2156

5

COLORADO DEPARTMENT OF HEALTH

Richard D. Lamm
Governor

Thomas M. Vernon, M.D.
Executive Director

September 1, 1986

Steve Norris
Colorado Joint Review Process
Department of Natural Resources
1313 Sherman Street
Denver, Colorado 80203

SUBJECT: Wolf Ridge Nahcolite Mine EIS
Comments

Dear Mr. Norris:

Staff had the following comments on the EIS.

Dispersion modeling was performed using Complex I and meterological data from the C-a Oil Shale tract, 6 miles to the southwest. What and how many years of this meteorological data were used in the modeling? Is the terrain at C-a similar to that at the Nahcolite Mine site? 1

Table 4.1 whows the air quality impacts of the four alternatives. Only the largest alternative (500,000 TPY) appears to have a problem. The Class 2 TSP increment is predicted to be violated. The preferred alternative (125,000 TPY) has no problems with ambient air standards, PSD increments or Class I area impacts.

Sincerely,

Ray Mohr
Senior Planner
Air Quality Control Division

RM/jb

cc: Tom Tayon, OHP

RECEIVED
SEP 12 1986
DEPARTMENT OF HEALTH

4210 EAST 11TH AVENUE DENVER,COLORADO 80220 PHONE (303) 320-8333

5

Divisional Correspondence Only

STATE OF COLORADO

DIVISION OF WILDLIFE

DEPARTMENT OF NATURAL RESOURCES

DATE: September 2, 1986

TO: STATE CLEARINGHOUSE

FROM: JIM MORRIS, WILDLIFE BIOLOGIST Jim Morris

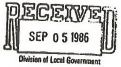
Division of Wildlife personnel have reviewed the draft EIS for the Wolf Ridge Corporation nahcolite solution mine. Division employees were involved with this project during scoping baseline and writing of this document. The proposed committed mitigation will compensate for habitat loss and alleviates our problems with the proposed action.

We appreciate the consultation by the project proponent and BLM early in the planning process.

2-6

JM:jg

xc: Tully
File



6

WWE

Wright Water Engineers, Inc.

DENVER OFFICE
2490 West 26th Ave., Suite 55A
Denver, Colorado 80211
(303) 480-1700

TULSA OFFICE
707 South Houston, Suite 302
Tulsa, Oklahoma 74127
(918) 584-7136

GLENWOOD SPRINGS OFFICE
818 Colorado Avenue
P.O. Box 219
Glenwood Springs, Colorado 81602
(303) 945-7755
Denver Direct Line: 893-1608

September 19, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P.O. Box 928
Meeker, CO 81641

Re: Response by Wright Water Engineers, Inc., Concerning "Draft Environmental Impact Statement Wolf Ridge Corporation Mine Plan for Nahcolite Solution Mine", July 1986. Reply Reference No. 1972(162)3500

Dear Mr. Frank:

Thank you for the opportunity to present a brief oral response to the draft EIS on August 27, 1986 in Grand Junction, Colorado. At the public meeting, I made an oral response concerning collapse of the solution cavities and turbulent flow, hydraulic connection of the aquifers, and reference to a 100-foot head difference between the two aquifers.

The following is an elaboration of the oral response plus additional comments.

1. I would like to stress the need for the public agencies and industrial water consultants to abandon the upper and lower aquifer terminology. The continued use of this nomenclature adds to the existing confusion of the Piceance Creek Basin hydrology. Stratigraphic, structural, and hydrologic evidence in that portion of the basin beneath the Wolf Ridge Corporation leases indicates hydraulic connection of the "two aquifers". Therefore, discussion of the groundwater hydrology should be concerned with "the aquifer", not the "upper" and "lower" aquifers.

   It is apparent throughout the EIS that the "upper" and "lower" aquifers are considered or implied to be hydraulically disconnected.

   A preponderance of the data amassed by Wolf Ridge consultants show definite hydraulic connection between the so called "upper" and "lower" aquifers. These data should be acknowledged and used unless there are data to prove otherwise.

55, 56, 60

2. Catastrophic collapse of the solution cavities (p. 4-12) depicts turbulent flow and mixing of brine and the fresh water aquifer; thus causing an increase in the White River salt load.

   The EIS depicts the unlikely occurrence of a catastrophic collapse and should emphasize such. If collapse occurs it will probably not be catastrophic, however, in any case the brine freshwater mix will again separate due to a density difference. 56

   I do not know of any data manipulation that predicts the timing of salt load increase to the White River as a result of collapsed mine cavities.

3. Hydraulic connection of the "two" historically separated aquifers has been shown by Wright Water Engineers and other geological and groundwater scientist, to exist. I think the BLM could take a more firm stand as to the evidence for a hydraulic connection. Continued support for the "two" aquifer system whether implicit or explicit complicates the issues. 55, 56, 60

2-7

4. The stream depletion analysis by Wright Water Engineers for a pumping rate of 150 gpm (proposed acting mining operation) was submitted February 13, 1986. This pumping rate was revised to 109 gpm by Cliffs Engineering. and Wright Water Engineers revised the depletion analysis which was submitted March 31, 1986. At the end of 30 years net depletions to Piceance Creek will be 0.1 cfs (compared to 0.15 cfs published in EIS) and net depletions to Yellow Creek will be 0.06 cfs (compared to 0.09 cfs published in EIS).

   To be accurate relative to the mine plan operation, the EIS should use the 109 gpm scenario.

5. Related to the depletion analysis is the statement on page 4-8 of the EIS (Section 4.4.1, second paragraph). Wright Water Engineers did not make model runs after the pumping ends, therefore, no prediction was made as to the depletion lag time. Why speculate, if this number is needed the model run can be extended, however, this question is really for the augmentation plan analysis. 56, 60

6. On page 3-12 of the EIS. the statement is made that the head difference between the "upper" and "lower" aquifers ranges from 0 to 100 feet beneath the lease. Wright Water Engineers is not familiar with measurement that indicate anything close to 100 feet of head difference on the lease. It is our opinion that the 100-foot number came from plates 2 and 3 of our 1985 report. These maps were generated to show the general relationships between the heads of the so called two aquifers. The maps were not intended to be site specific for the sodium lease, but merely guides for the model calibration.

6

Thank you for your consideration of these comments. If Wright Water Engineers may be of additional assistance on behalf of Wolf Ridge Corporation, please call.

Very truly yours,

WRIGHT WATER ENGINEERS, INC.

By William H. Bellis

WHB:ard
821-049.000
(1.51)
cc: Ed Rosar
Bill Lorah
Jerry Daub

7

United States Department of the Interior

BUREAU OF RECLAMATION

ENGINEERING AND RESEARCH CENTER

P O BOX 25007
BUILDING 67, DENVER FEDERAL CENTER
DENVER, COLORADO 80225-0007

IN REPLY REFER TO: D-1000

SEP 19 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
PO Box 928
Meeker, Colorado 81641

Dear Mr. Frank:

This office has reviewed the Draft Environmental Impact Statement for the Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine (July 1986). Our review was focused primarily on the potential impacts on the Colorado River system, particularly salinity. While the use of 219 to 875 acre-feet per year of water for the project is considered minuscule in terms of depletions and salinity impacts, the basic water resource and quality aspects must be examined in larger context.

2-8

In order to obtain cumulative water depletions, the Wolf Ridge Mine estimates must be added to the following oil shale depletions for the Piceance Basin:

Federal Tracts	C-a	@ 33,000 barrels per day	6,200 acre/ft/year
	C-b	@ 14,000 barrels per day	2,263 acre/ft/year
Private Development (Exxon, Union, Chevron, and Pacific Shale)	Total	@ 194,000 barrels per day	38,865 acre/ft/year

57

Thus, the cumulative total depletions for the area (including Wolf Ridge) could total more than 48,000 acre/ft/year of Colorado River Water or ground-water sources which supply the Colorado River.

This office has commented on all the oil shale (EIS) drafts with a consistent suggestion that a significant portion of this total water requirement could be met with the use of saline water from nearby sources such as Glenwood-Dotsero Springs.

In fact, we have recently completed an in-house study which examined the potential for use of saline water in the solution mining industry, and we think the concept has merit. Please share our study findings

7

(enclosure) with Wolf Ridge Corporation representatives. Although the proposed water supply has been adequately described for purposes of the EIS, it should be at least acknowledged that alternative supplies may be considered to conserve freshwater sources.

57

Finally, we note that the proposed solution mine could produce from 50,000 to 500,000 tons per year of nahcolite. Even if brine leakage from mine cavities, process facilities, and from other sources could be held to 10 percent; 5,000 to 50,000 tons of new salts is a very significant potential source of salt loading to the Colorado River. As such, we can only emphasize the importance of the proposed ground-water monitoring wells and intensive surface water monitoring. Additional controls or mitigation measures may have to be considered if monitoring reveals any new salt loading to the river system.

27, 56

Sincerely yours,

Al R. Jonez, Chief
Colorado River Water Quality Office

Enclosure

8

.eptember 20, 1976
710 Road 35.8
Palisade, Colorado 81526

Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P.O. Box 928
Meeker, Colorado 81641

Dear Mr. Frank:

I read, with interest, the proposed solution mining of nahcolite in the Piceance Basin in the Wolf Ridge Corporation EIS. Development of the valuable resources in Piceance Basin should, indeed, be encouraged through innovative ventures such as proposed by the Wolf Ridge Corporation. Because the intermingled resources of oil shale, nahcolite and dawsonite are currently of little commercial value and yet offer a tremendous future potential value as this nation's resources are further depleted, resource managers should proceed with great caution in any and all development of this unique suite of resources

2-9

The saline zone in the Piceance Basin is being dissolved away ever so slowly due to a delicate three-fold balance between, (1) fresh ground water, (2) highly saturated water at the dissolution surface, and (3) the uppermost part of the highly soluble saline minerals at the contact point.

Caving from the proposed project will cause disturbances to this delicate balance by increasing water flow at the dissolution surface and will certainly increase the rate of leaching of salts (nahcolite-sodium bicarbonate and halite-sodium chlorides) from this saline zone. The result will be to dissolve some of the solid saline resource and to increase groundwater degradation. Caving and subsidence of the overlying oil shale resource will be further encouraged. The rate of leaching will increase with additional subsidence and the subsequent fracturing of overlying oil shale strata. 56, 80

The EIS neglects to address the weakening effect of hot process water on the integrity of the overlying rich oil shale and nahcolite strata directly above the resulting solution cavities. Important also, is the fact that a relatively long period of elevated temperature exposure of the adjacent supporting structure (pillars and roof) around the developing solution cavaties will further deteriorate the rock strength in these important supporting structures. Subsequent cooling around the solution cavities will be quite slow due to the slow thermal conduction of the remaining structure. The net effect

8

is long term exposure to elevated temperatures , resulting in poorer rock supporting capabilities of the overlying structure surrounding solution cavaties that is supposed to limit the effect of the solution mining on the overlying oil shale.

Because of the quite close proximity of the solution cavaties to the overlying dissolution surface of the saline zone, it is highly likely, as shown in Figure 4-1 of the DEIS, that deleterious caving and subsidence and the resulting fracturing into the leached zone will occur rather quickly. This fracturing will lead to ground water degradation and saline zone leaching at a rate quicker than projected in the EIS 56, 80

The groundwater and subsidence monitoring proposed for this development is severely deficient. Only through an extensive groundwater monitoring program, both up and down gradient from the project, will the early deleterious effects be detected soon enough to avoid disastrous effects on the mineral resource and on groundwater.

My concern for premature rock failure is based, not upon idle speculation, but on laboratory data showing low temperature structural failure of oil shale reported by Smith and Johnson, (A.C.S. Preprints, Div. of Fuel Chem., vol 21, No. 6, 1976, pp. 25-33.) and on experience with EIS retort roof failure at Tract C-a and Occidental's Logan Wash facility. (This mechnism for such failures is briefly described in a note at the end of this letter.) In fact, concern for low temperature roof failure prompted a research proposal to evaluate structural failure of large blocks of oil shale at low temperatures. Occidental has obtained several patents on procedures to control heating of overlying strata above their EIS retorts during ignition, because of their experience with roof falls during ignition

The potential problem of deleterious effects on the oil shale resource was also appropriately taken into account by the writers of the sodium lease as evidenced by wording in the sodium lease designed to protect the oil shale (See Section 1. c. on page 6.5-2 of this EIS).

In summary, I am concerned that the development plan does not adequately protect the extensive suite of mineral resources or the groundwater. The monitoring plan is not adequate to detect problems before serious degradation occurs. 56, 80

Note: Oil shale laminations throughout the Green River Formation

8

result from differing depositional environments during the lake's existance. Oil shale mineral compositions vary due to changes reflected in the different laminations as shown by Robb and Smith, (Guidebook to the Energy Resources of the Piceance Creek Basin, Colorado, Twenty-Fifth Field Conf., Rocky Mountain Association of Geologists, 1974, pp. 91-100). Thermal expansion properties vary with these different depositional features, and thus vary between adjacent laminations and beds. This heterogeneity promotes rock failure when temperature changes are induced in the oil shale.

Sincerely,

Donald R. Johnson

Donald R. Johnson

2-10

9

United States Department of the Interior

NATIONAL PARK SERVICE

ROCKY MOUNTAIN REGIONAL OFFICE

655 Parfet Street

P.O. Box 25287

Denver, Colorado 80225

IN REPLY REFER TO:

L7617 (RMR-PP)

SEP 22 1986

Memorendum

To: Project Coordinator, Bureau of Land Management, White River Resource Area, Meeker, Colorado

From: Associate Regional Director, Planning and Resource Preservation, Rocky Mountain Region

Subject: Review of Dreft Environmental Impact Statement for the Wolf Ridge Corporation Mine Plen, Bureau of Land Management - Nahcolite Solution Mine (DES-86/31)

We reviewed the subject dreft Environmental Impact Statement (EIS) and offer the following comments.

Impacts of the proposed ection - extract 125,000 tons of nahcolite per year for 30 yesrs - appear to be minimal. We concur with the Bureau of Land Management's preference for the proposed ection.

Especially important, we believe, is the neer-absence of loss of any significant plent end enimal habitat, end the lack of significent impacts on eir and water quality under the preferred elternative.

We would, however, like to go on record es opposing any altemative that would increase air pollution to any significant degree. The proposed mine would be located in Rio Blanco County approximately 35 miles southeast of Dinosaur National Monument and 65 miles northeast of Colorado National Monument, both Class II areas under the Clean Air Act as well es Colorado Category I areas for sulfur dioxide. Under the proposed action, the predicted maximum air pollutant ambient concentrations would be fugitive dust resulting from mining and product handling activities. These emissions normally fell out quickly end usually have no significant impacts at long downwind distances.

Under the 500,000 tons per year alternative, the gas-fired boiler that would be employed with the proposed action would be replaced by a coal-fired boiler. This change, along with the increase in capacity, would result in far greater emissions of sulfur dioxide and particulate matter than the proposed action. Although the baghouse/electrostatic precipitator and flue gas desulfurization system proposed to control emissions from the coal-fired boiler may represent the best available control technology, exceedences of the Prevention of Significant Deterioration Class II increments would be expected, and potential adverse impacts to State Category I air quality related values from acid deposition may occur.

9

In summary, there would probably be no significant air quality impacts on either Dinosaur National Monument or Colorado National Monument if the proposed action is implemented. However, the draft EIS should be revised to include discussion of additional control measures to be applied under the 500,000 tons per year alternative in order to assure that there would be no increment exceedences or adverse impacts on the air quality related values for either of the National Monuments. 2

Please call Erik R. Hauge at commercial 303-236-8761 if you have any questions on our comments regarding air quality. We appreciated the opportunity to comment on the draft EIS.

Richard A. Strait

10

United States Department of the Interior
GEOLOGICAL SURVEY
BOX 25046 MS-939
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

Office of Energy and Marine Geology
Branch of Energy Minerals

September 23, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P.O. Box 928
Meeker, Colorado 81641

Dear Mr. Frank:

The draft EIS for the Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine dated July 1986 was reviewed on behalf of this office. Solution mining of nahcolite as outlined in the EIS runs the risk of causing serious damage to the oil-shale resource and associated minerals on the sodium lease lands. The possibility of collapse and fracturing of the oil shales overlying the Boles nahcolite bed would lessen the value of the oil-shale resource for future mining because of weakened strata, introduce commingling of fresh and saline waters between aquifers, and cause dissolution of nahcolite and halite below the dissolution surface. 36, 58

The exact configuration of the dissolution surface on the sodium lease lands is still not clearly defined by core hole data, but available data suggest that the surface is an undulate but fairly smooth plane; rather than a highly irregular surface. If the dissolution surface were breached by solution mining of nahcolite, it could become very difficult to predict the position of the dissolution surface in the future, even by fairly closely spaced drill holes. Therefore, significant oil-shale resources and nahcolite below the dissolution surface may become unrecoverable because of changes in the configuration of the dissolution surface caused by solution mining. 35

Unfortunately, the EIS treats nahcolite and oil shale as two separate commodities which they are not. Both are part of one multimineral resource. The maximum utilization of these resources would be best achieved by mining them as a single deposit. Also consider that oil-shale is a nonrenewable resource of fossil fuel, whereas, synthethic nahcolite can be manufactured from trona or by the Solvay process. The best interests of the United States Government and the public might be better served by preserving all of the oil-shale deposit on the sodium lease lands for future use, or at least to coproduce it with the nahcolite, in order to avoid the possible loss of some of the best oil-shale resources in the Piceance Creek basin. 31

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Some comments specific to the EIS follow:

Page 1-3, para. 3. In view of the less controllable method of solution mining, mining to within 50 feet of a lease boundary seems much too lenient. If the oil shale and nahcolite on adjoining Federal lands is impaired, are there any provisions for indemnification for loss of oil shale, nahcolite, and ground water resources on these lands by the lessee? 22

Page 2-8, para. 2.2.12.3. If substantial subsidence occurs, what steps would be taken by BLM to correct the problem? Provisions for payment by the lessee for damage to oil shale on the sodium leases that might be caused by solution mining of nahcolite should be included in this EIS. 45

Page 3-6, para. 3.2.3. The EIS states that the oil shale in the leached zone is too incompetent to mine by conventional means. What about MIS methods? Most of the oil shale on the C-a and C-b tracts has been leached of nahcolite and can be considered part of the leached zone. On the C-b tract, mining plans include retorting oil shale by an MIS method in parts of the Mahogany Zone, B-groove, and R-6 oil-shale zones. On the C-a tract, the MIS retort No.1, which was sucessfully burned, extends vertically from the middle of the R-5 through the R-6 to nearly the top of the Mahogany Zone. These oil shales contain rubbly zones and solution breccias. Without a comparison of the rock properties of the leached oil shale on the C-b and C-a tracts with the properties of the oil shale in the leached zone on the sodium lease lands, the conclusion that the leached zone on the sodium lands cannot be mined is untenable. The oil shale in the leached zone on the sodium leases should be considered as recoverable resources that could be seriously impaired or lost by solution mining of the Boies bed. 32

Page 3-7, fig. 3-1A. The stratigraphy is too generalized to clearly see the relationships between oil shale, nahcolite, and dawsonite. Profiles of Fischer assays, nahcolite, and dawsonite for one of the Industrial Resouces core holes on the sodium lease lands should be shown to give the reader some idea of the vertical distribution and abundances of these resources on the sodium lease lands, similar to that published by Cole, Daub, and Welchman (1982, Geology of the Horse Draw nahcolite and oil-shale mine, Piceance Creek Basin, Colorado [in] 15th Oil Shale Symposium Proceedings: Colo. Sch. Mines, p. 15-28). 43

10

Page 3-8, para. 3.3.2. The treatment of oil shale resources in this section is not adequate. Estimates of the total tonnages of oil shale--principally in the R-6 and Mahogany zones--that could be adversely affected by solution mining should be included in a table. The total amount of nahcolite that would be recovered by the proposed solution mining plan should also be included. The amount of in-place shale-oil resources for the Mahogany and R-6 zones on the 219-acre well-field area under the Proposed Action is estimated at 140 million barrels that could be adversely affected by solution mining, as opposed to production of an estimated 4 million tons of nahcolite (330 cavities x 12,000 tons of nahcolite per cavity). 33

Sincerely yours,

John R. Dyni, Geologist and
Thomas Fouch, Branch Chief

DAUB & ASSOCIATES
CONSULTING GEOLOGISTS
1980 SOUTH BROADWAY
GRAND JUNCTION, CO 81503-9593
(303) 241-0964

September 19, 1986

Mr. Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P.O. Box 928
Meeker, Colorado 81641

Dear Willy:

Enclosed are Daub & Associates' comments regarding the Draft Environmental Impact Statement for Wolf Ridge Corporation's Mine Plan for a Nahcolite Solution Mine. We feel the Bureau of Land Management has done a good job and should be commended on their efforts.

2-13

Daub & Associates has based their comments on over six years of detailed work, site specific to the central Piceance Creek Basin and in particular, to the Wolf Ridge Corporation's sodium leases. Our work has included the geologic, hydrologic, engineering, drilling and rock mechanics aspects of the Wolf Ridge Corporation's sodium leases. Daub & Associates has also based their comments on the detailed evaluation of over 30,000 feet of drill core from the sodium leases.

The beneficial uses of sodium bicarbonate are many and the environmental cleansing aspect of sodium bicarbonate as a dry flue gas scrubbing agent is extremely attractive.

We feel that the commercial phase of the project should proceed unimpeded. The northwest and west-central Colorado economic conditions would be bolstered by the commercial production of nahcolite. The environment stands to gain from the numerous beneficial uses of sodium bicarbonate.

Daub & Associates wish to thank you for the opportunity to comment on the Draft Environmental Impact Statement.

Sincerely,

Jerry Daub
President
DAUB & ASSOCIATES
CONSULTING GEOLOGISTS

cc: E. Rosar

11

DAUB & ASSOCIATES
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1980 SOUTH BROADWAY
GRAND JUNCTION, CO 81503-9593
(303) 241-0964

11

DAUB & ASSOCIATES
CONSULTING GEOLOGISTS

1980 SOUTH BROADWAY
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(303) 241-0964

DAUB & ASSOCIATES' COMMENTS ON THE DRAFT

ENVIRONMENTAL IMPACT STATEMENT

WOLF RIDGE CORPORATION MINE PLAN

for a

HANCOLITE SOLUTION MINE

2-14

The comments will be listed by page number, heading, paragraph number and sentence number. The words or sentences in hold and underlined in the comments are sections that we feel should ha included in the final EIS. All of the exhibits whicb are referred to are located at the end of our text.

Pg. #	Heading	Prgh. #	Sent. #	Comments	
S-1	No Action Alternative	1	1	Sentence should read 6-ton per hour (tph).	49
S-1	No Action Alternative	4	4	However, the surface disturbance and facility will occupy a small areal extent.	47
S-1	No Action Alternative	5	1	The use of ground water for the pilot plant project will have a very minimal effect on the surface water system.	58
S-1	Proposed Action	3	4	It is hard to estimate the areal extent of the L-5 zone which is salt and in contact with the lower aquifer. How was this accomplished? What assumptions were made to state there would he a 20% increase in the salt/lower aquifer contact?	59

11

DAUB & ASSOCIATES
CONSULTING GEOLOGISTS

1980 SOUTH BROADWAY
GRAND JUNCTION, CO 81503-9593
(303) 241-0964

Pg. #	Heading	Prgh. #	Sent. #	Comments	
2-13	2.3.1.7.2	1	1	Other alternatives would include expanding the existing ponds or to creats a new pond.	52
2-13	2.3.1.7.3	2	5	The WRC's studies indicate that the best method to complete and abandon the production wells, is outlined in Exhibit A which was submitted to the BLM on Jnnuary 16, 1986. Exhibit B illustrates the WRC's well shandonment procedures.	83
2-13	2.3.1.7.3	5	1	The WRC's studies indicate that the best metbod of well completion for operation of the wells is to utilize a competent casing pack in the annulus between the well bore and the 8 5/8" well casing. The casing pack would extend from the top of the annular cement to surface. Exhibit C illustrates tbis procedure.	
2-13	2.3.1.7.3	6	1	There would be no need to haul the drilling fluid material to the evaporation pond. The fluid may be reused or what little fluid remained could be allowed to evaporate prior to reclamation of the mud pit.	53
2-13	2.3.1.7.4	2	4	Daub & Associates feels that monthly sampling need not continue for 3 years after mining has been completed. Monthly measurements for one year should be sufficient.	24, 26, 56
2-13	2.3.1.7.4	3	Trace Components	The list of trace components appears to be far too extensive. There is no need to perform comprehensive grass roots	25, 49, 56

DAUB & ASSOCIATES
CONSULTING GEOLOGISTS
1980 SOUTH BROADWAY
GRAND JUNCTION, CO 81503-9593
(303) 241-0964

Pg. #	Heading	Prgh. #	Sent. #	Comments	
				quantitative analyses on the lower aquifer for so many trace elements. This is especially true when these values have such a wide natural range or variation.	25, 49, 56
2-14	2.3.1.7.5	2	1	The cement bond logs and/or temperature logs shall be submitted to the authorized officer within 10 days after logging.	84
2-15	2.3.1.7.6	16	1	Seed rate should read: ÷ 0.9 x 0.7 = 1.5 lb. per acre.	49
2-17	2.3.2.2	1	1	Approximately 215 acres (115 acres would be disturbed at 5 acres per year) of additional land....	48
2-25 and 2-26	2.4.1.1.4	2	5	The WRC's studies indicate that the best method to complete and abandon the production wells, is outlined in exhibit A which was submitted to the BLM on January 16, 1986. Exhibit B illustrates WRC's well abandonment procedures.	83
2-26	2.4.1.1.4	6	1	The WRC's studies indicate that the best method of well completion for operation of the wells is to utilize a competent casing pack in the annulus between the well bore and the 8 5/8" well casing. The casing pack would extend from the top of the annular cement to surface. Exhibit C illustrates this procedure.	
				... and a cement bond and/or a temperature log shall be run for this interval.	84

2-15

11

DAUB & ASSOCIATES
CONSULTING GEOLOGISTS
1980 SOUTH BROADWAY
GRAND JUNCTION, CO 81503-9593
(303) 241-0964

Pg. #	Heading	Prgh. #	Sent. #	Comments	
2-26	2.4.1.1.4	7	1	There would be no need to haul the drilling fluid material to the evaporation pond. The fluid may be reused or what little fluid remained could be allowed to evaporate prior to reclamation of the mud pit.	53
2-26	2.4.1.1.5	2	1-4	The lowermost part of the lower aquifer is the only interval which would require monitoring. There is no need or justification to monitor the B-Groove. Daub & Associates feels that monthly sampling need not continue for 3 years after mining has been completed. Monthly measurements for one year should be sufficient.	24, 30, 56
2-26	2.4.1.1.5	3	Trace Components	The list of trace components appears to be far too extensive. There is no need to perform comprehensive grass roots quantitative analyses on the lower aquifer for so many trace elements. This is especially true when these values have such a wide natural range or variation.	25, 49, 56
2-27	2.4.1.1.5	5	1-3	The proposed hydrologic monitoring wells will suffice for the so called "dedicated hydrologic monitoring wells". There is no need to drill and complete new hydrologic monitoring wells when the proposed wells will be utilized as such.	28
2-27	2.4.1.1.5	5	4	Monitoring of the ground water will commence at least 3 months prior to the start of mining. There is no need to initiate monitoring 6 months prior to	24, 26

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				mining.
2-27	2.4.1.1.5	9	3	Daub & Associates feels that monthly sampling need not continue for 3 years after mining has been completed. Monthly measurements for one year should be sufficient. [24, 26]
2-27	2.4.1.1.6	2	1	The cement bond and/or temperature logs shall be submitted to the authorized officer within 10 days after logging. [84]
2-28	2.4.1.1.7	9	1	Monitoring the reclaimed areas for one complete growing season should suffice. [37]
2-30	2.4.1.1.10	3	1	The designated operator/lessee shall regularly maintain the road during plant operation in a safe, useable condition. [17]
2-34	Table 2-2	4	2 Fluid Minerals	Future development of surface facilities and well drilling operations may be complicated. [15]
2-34	Table 2-2	5	2 Solid Minerals	Sodium resources within a small part of the L-5E bed potentially impacted... The resources within the entire L-5E bed would not be impacted. [49]
2-35	Table 2-2	3	1 Vegetation	Natural vegetation communities lost to surface disturbance on 43 acres for a temporary period of time. [50]

2-16

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Pg. #	Heading	Prgh. #	Sent. #	Comments
3-6	3.2.2.2	2	2	From the middle Mahogany to the dissolution surface,... The very poor rock quality extends from the middle Mahogany zone to the dissolution surface.
3-6	3.2.2.2	2	3	Because less nahcolite was present for leaching in most of the upper Mahogany and R-8 zones, the secondary effects are less pronounced there, however, numerous dissolution features including vugs, pits, voids, collapse breccias, rubble zones, joints and fractures extend up through the entire Mahogany zone into the top of the R-8 zone. [49]
3-6	3.2.3	2	1	That portion of the leached zone up to and including the middle Mahogany zone... The very poor rock quality extends up to and includes the middle Mahogany zone.
3-6	3.2.3	3	2	However, an interval in the upper Mahogany zone, about 40 feet in thickness, has been identified that could be suitable for conventional room and piller mining if the stratigraphic sections both above and below this 40 foot interval were downcored. Only a 40 foot interval appears to be suitable for underground mining. [34]
3-7	Figure 3-1A			The leached zone should extend up to the top of the R-8 zone and the lower aquifer should extend up to the middle Mahogany zone as depicted in exhibit D. This [43, 44]

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				subject has been discussed in a paper presented at the 18th Colorado School of Mines Oil Shale Symposium entitled "Detailed Lithologic, Rock Quality, and Hydrologic Data From Four Drill Holes in the Central Piceance Creek Basin, Rio Blanco County, Colorado."	43, 44
3-8	3.3.2	1	4	Although the leached interval below the middle Mahogany zone contains significant quantities...	44
				The leached zone refers to the entire section from the dissolution surface to the top of the R-8 zone including all of the Mahogany zone.	49
3-9	3.4.1.1	7	13	... from the drainage areas within the leases ...	60
3-9	3.4.2			Heading should be Regional Setting below Ground water.	
3-9	3.4.2	1	1	... of the Uinta and Green River Formations. However, beneath the WRC oeding leases in the north central Piceance Creek Basin these aquifers are presently in communication and considered one.	55, 60
3-9	3.4.2	2	2	These aquifers are hydraulically connected with one another. The aquifers can NOT be considered as separate reservoirs.	
3-11	Figure 3-2			The top of the lower aquifer should be extended up into the middle of the Mahogany zone.	

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
3-12	3.4.2	3	2	These two aquifers are generally seperated by the upper Mahogany zone...	60, 61
3-12	3.4.2	3	3	The upper Mahogany zone is probably a leaky semi-confining layer between the two aquifers, which allows some communication between the two aquifers through secondary porosity developed in joints, dissolution features and fractures in the upper Mahogany zone.	
3-12	3.4.2	3	4	Because of its high kerogen content, the rock is less brittle; therefore, the upper Mahogany zone is less susceptible to fracturing than is either the rock containing the upper or lower aquifers.	
3-12	3.4.2	3	5	In some places in the basin the upper Mahogany zone is ...	
3-12	3.4.2	4	2	This means that the water level of a well in the water bearing zones will be higher than the base of the confining layer. As it is now stated in the draft EIS it is an incorrect definition.	60
3-12	3.4.2	4	6	The presence of dissolution features, faulting and fracturing in confining layers that ... Where there is an abundance of dissolution features, fracturing and faulting, head differences are less than where there is minor or insignificant fractures, faulting and dissolution features (Between	

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				and Saulnier, 1981, Wright Water Engineers and Daub & Associates, 1990).
3-12	3.4.2	6	4	The base of the lower aquifer is directly overlying the saline mineral and oil shale intervals, which make up ...
				Beds of salt may be misleading.
3-12	3.4.2	7	2	In the Piceance Creek Basin, secondary porosity is created principally by fracturing, jointing, faulting and by dissolution .....
3-12	3.4.2	7	3	... wide variations in permeability. The dissolution of the abundant saline minerals and resulting fracturing in this portion of the basin has been the major contributing factor to the secondary porosity.
3-12	3.4.2	8	1	At the site of the WRC lease, a perched aquifer which ...
3-12	3.4.2	9		Site specific should be at the heading of this paragraph.
3-12	3.4.2	9	1	The hydraulic head difference between the upper and lower aquifers ranges from 0-10 feet within the ...
3-12	3.4.2	9	2	The difference in hydraulic head near the proposed ...
3-12	3.4.2	9	3	Approximately the lower half of

60

2-18

9

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				the Mahogany zone within the lease area has abundant dissolution features ...
3-12	3.4.2	10	1	Pump tests done by the Multi Mineral ...
				No s on Mineral.
3-12	3.4.2	12	1	This sentence is redundant, this has already been stated in paragraph 8.
3-12	3.4.3	-	-	Regional should be a subheading beneath Ground water Quality.
3-13	3.4.3	4		Site specific should precede this paragraph.
3-13	3.4.3	4	2	... of calcium, magnesium, and sulfate. However, site specific water chemistry between the two aquifers appears to be very similar as illustrated by Exhibit E.
3-13	3.4.3	5	1	The upper aquifer within the sodium lease tracts does not meet the ...
				Remove always. Space needed between flouride and end.
3-13	3.4.3	5	8	From what source does this date originate?
3-14	3.4.5	2	2	... intensity localized thunderstorms. The mine site and support facilities are located

60

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60

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				wall above these drainages and are not located on or near the floodplain.	60
3-17	3.5.1	1	2	When you talk about downstream, what stream are you referring to?	12, 49
4-3	4.1.1	5D	1	however, there will be a potential for ...	
4-6	4.2.2.2	1	6	The rock quality of the majority of the stratigraphic section above the dissolution surface is already very poor.	
2-19				Remove to the Mahogany zone. The Mahogany zone has very poor rock quality in part. This is already stated by referring to the majority.	49
4-5	4.2.2.2	1	7	... affect rock quality of the overlying strata immediately overlying the cavity.	
4-5	4.2.2.2	2	8	... on the rock quality of the Mahogany zone because of caving. Rock quality in the lower leached zone is already very poor and no real adverse impact would result to the rock through this stratigraphic interval.	40
4-6	4.2.2.2	4	2	... at the tops of the pillars. Since the top of the pillars are in nahcolite, the crumbling of these pillars would resemble more of a plastic flow due to the nature of the nahcolite. There is no need to include the	49

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				word (failure) in the preceding sentence.	49
4-5	4.2.2.2	4	7	... overlying the cavities up into the very poor rock quality of the leached zone.	
4-7	4.3.1	2	2	It is hard to conceive that the borehole may be lost and that the mined out cavities could not be drilled through. Natural subsidence and very poor rock quality is already prevalent with numerous voids from the natural dissolution of saline minerals.	15
4-8	4.3.2.2	1	3	To ensure that there were no open voids left across the Mahogany zone, the entire zone would be plugged upon well abandonment. The sentence would read better and is more accurate. There is no real potential for gas to accumulate across this interval. No gas has ever been detected in the Parachute Creek member until the saline zone has been penetrated. The leached zone (R-8 to the dissolution surface) is much too permeable and porous to allow the accumulation of significant amounts of natural gas. The abandoned well will contain a competent plugging gel. Cement across this interval is not a necessity and plugging gel is more than adequate.	83, 85
4-8	4.3.2.2	2	8	Sodium resources within part of the L-5E bed could also ... Only part of L-5E bed would be	49

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				affected. 49
4-8	4.4.1	1	3	The void spaces left by removal of the sodium would contain briney water.
4-8	4.4.1	3	2	... not be greater (Wright Water Engineers and Daub & Associates, 1985).
4-10	4.4.2	4	4	It is hard to believe that fluids from the evaporation ponds could travel the 3 - 5 or 6 miles it would take to reach Yellow Creek. Would the fluids ever reach Yellow Creek? 56
2-20				
4-11	4.4.4.1	1	4	These affects would cause a change in the location of the water. The waters would not necessarily mix.
4-11	4.4.4.1	3	1	Based on an aquifer pump test ...
4-11	4.4.4.1	3	4	This means that there is more ... Remove the word may. This is a known fact.
4-11	4.4.4.1	4	1	The "rubber beds" are three thin (2-3 feet thick each) beds of very ...
4-11	4.4.4.1	4	2	Experience obtained during drilling indicates that these beds would probably seal cracks in the rock by swelling into the crack. 23, 49 Remove "small (1 millimeter or less)". The rubber beds have been

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				observed and measured to swell far in excess of 1 mm. 23, 49
4-11	4.4.4.1	4	4	The beds probably would have some mitigative effect. Remove the rest of the sentence "because ... It should be noted that they are thick, very competent and have very unique sealing characteristics. They very well may seal mine cavities from the base of the lower aquifer.
4-11	4.4.5			Ground Water (2 words)
4-11	4.4.5.1	1	2	This impact could occur as a result of brine leaking through well casings which is very remote or through ... 23, 50, 56
4-12	4.4.5.1	3	1	An undetected leak (less than 3 gpm) in the upper part of the casing is highly unlikely since all casing will be inspected prior to installation. The production wells will be operated for a relatively short period of time. In addition, any fluid escaping into the upper groundwater system would require a break or failure in both the 9 1/2" production casing as well as the 8 5/8" outer well casing. This particular situation is extremely remote. Remove the rest of the sentence "would also be ...."

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				Remove sentence "Over the life of the cavity..."	23, 30, 56,
4-12	4.4.5.1	3	3	Since the potential for a double casing failure is so remote, there would be no need to monitor the B-Groove ground water system.	
4-12	4.4.5.1	4	1	Significant impacts to the lowermost ground water quality...	
4-12	4.4.5.1	4	2	In this case, the brine from the cavity will stay along the dissolution surface due to the permeability and porosity of the rock as well as the fact that the saturated solution from the cavity will be much denser and tend to remain below the lighter less saline fluid.	
				Remove the rest of the sentence "the collapse zone...	56, 63
				The ground water in the lowermost part of the lower aquifer in not relatively fresh. The dissolution process in a natural hydrogeologic condition that is occurring today. The fluid at the dissolution surface is highly saline and the addition of a small amount of brine would not significantly alter the gaohydrologic system.	
4-12	4.4.5.1	4	3	This could slightly degrade the quality of the water, immediately above the dissolution surface.	56, 64
4-12	4.4.5.1	4	4	The roof of the mining zone could collapse after a 1000 foot by 1000 foot area was developed by a	38, 49

2-21

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				commercial - scale ...	38 49
4-12	4.4.5.1	4	5	... physical connection between the lowermost part of the lower aquifer and the brines in the cavity could be established.	56
4-12	4.4.5.1	4	7	This would probably be true if the roof did not collapse.	
4-12	4.4.5.1	4	7	Critical widtb is not anticipated until after 4 years of commercial production at 125,000 TPY.	38 49
4-12	4.4.5.1	5	1	It must be understood that the ground water in the lowermost part of the lower aquifer is not relatively fresh but saline to highly saline...	
				... to remain isolated from the water in the lower aquifer, because the brines are more dense and more viscous than the fresher water.	
				Remove "relatively fresh" and "relatively".	56
4-12	4.4.5.1	5	7	... lower aquifer take place at very slow rates. Dissolution of saline minerals by the lower aquifer are natural geologic processes which are occurring today. The rate at which these processes take place is not known and may be quite variable.	
4-12	4.4.5.1	6	1	... quality of the lowermost part of the lower aquifer would...	

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
4-12	4.4.5.1	7	2 & 3	It is inconceivable to have turbulent flow, even with cavity collapse, due to the permeability and porosity values which exist in the rocks above the cavities. Fluids will take the path of least resistance and may stay entirely below the dissolution surface as a result of the confining beds. There are no subsurface rivers or lakes that exist in which turbulent flow could occur. Sentences 2 and 3 of this paragraph should be removed since turbulent flow would probably not occur.	56
4-12	4.4.5.1	7	5	It is not anticipated that cavity collapse would occur for 200 to 1,000 years. If in fact it did, this would be a slow collapse and not the catastrophic collapse which has been discussed in the preceding sentences. Turbulent flow could not exist for 200 - 1000 years even if the geohydrologic conditions were right for such mixing.	56, 65
4-12	4.4.5.1	8	1	... action will be required. Due to the structural configuration of the dissolution surface beneath the WRC's leases, any brines which might escape the cavities will be confined to the area immediately above the dissolution surface in a low area or basin.	28, 66
4-12	4.4.5.1	9	5	There is a very low probability that...	67
4-13	4.4.5.4	1	2	... in contact with salt would	56

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				increase by less than 10 percent within the leases; however, this would only be less than a .5 percent ...	56
4-13	4.4.5.5	1	3	... hydraulic connection between the saline water of the lower aquifer and the brines of the cavities. It should be noted that the water immediately overlying the dissolution surface is of very poor quality and has high TDS and conductivity levels.	60
4-13	4.5	2	1	Spills of pregnant solution (sodium bicarbonate) could occur... Nahcolite is a naturally occurring mineral and after it is dissolved in the mining process should be referred to as sodium bicarbonate.	49
4-13	4.5	2	2	Surface spillage of sodium bicarbonate would result...	
4-13	4.5	2	5	The overall impact on soils from possible sodium bicarbonate spillage...	
4-14	4.5.1	1	1	... downstream along Yellow Creek might be impacted. Remove "significantly". It is not likely that any significant impact would occur.	13
4-17	4.9.1	5	2	The vehicle related deer kills during 1977-1981 is probably biased toward the high side due to	89

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				the expanding growth period and development of numerous energy related projects which are not in operation and/or greatly reduced today. Baseline data is probably high.	89
4-19	4.9.3	3	2	On what data in the BLM basing the 20-40% reduction in flow for Yellow Creek? How were these figures calculated? It is doubtful that Yellow Creek will see such reduced flows.	
2-23				The water needs for the commercial -scale operation were revised and Wright Water Engineers, Inc. submitted a revised stream depletion report dated March 31, 1986. The revised water requirements are based on 109 gpm for years 3 through 30 for the proposed action and 436 gpm for years 3 through 30 for the 500,000 TPY operation. In the draft E.I.S. the associated stream depletion for the surrounding area were based on 150 and 600 gpm when they should be based on 109 and 436 gpm. Thus the reduction in flows of the surrounding streams will be less than what has been reported in the draft E.I.S.	56, 68
4-19	4.9.3	4	3	On what data is the BLM basing the 80% reduction in flow for Yellow Creek? How were these figures calculated?	
				The water needs for the commercial -scale operation were revised and Wright Water Engineers, Inc. submitted a revised stream depletion report dated March 31, 1986. The revised water requirements are based on 109 gpm	

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				for years 3 through 30 for the proposed action and 436 gpm for years 3 through 30 for the 500,000 TPY operation. In the draft E.I.S. the associated stream depletion for the surrounding area were based on 150 and 600 gpm when they should be based on 109 and 436 gpm. Thus the reduction in flows of the surrounding streams will be less than what has been reported in the draft E.I.S.	56 68
4-19	4.9.3	5	1	How was the 50 year recharge figure reached? On what data was the 50 year recharge figure based?	56 69
4-20	4.9.5	1	2	What is the BLM referring to when they state "all the projects in this area"? How many other projects are there?	9, 49
4-20	4.9.6	2	3	On what were the 20-40% reductions based? How were these figures derived? See page 4-19, 4.9.3, 4, 3 which refers to the revised water consumption values.	
4-20	4.9.6	3	3	On what were the 70-80% reductions based? How were these figures derived? On what is the statement "flow essentially absent from July through September" based? See page 4-19, 4.9.3, 4, 3 which refers to the revised water consumption values.	56 68
4-20	4.9.6	3	5	How was the figure of 20 years calculated? On what is the 20 year figure based?	56 69

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
4-30	4.18.1.2	1	1	... overlying the cavities between the top of the Boise Bed and 10-15 feet above the dissolution surface. The rock quality above this interval has already been "significantly reduced" by natural processes.	41
4-30	4.18.1.3	1	1	Sodium minerals within the L-5E Bed, lying...	
				The L-5E is a bed within the L-5 zone.	
4-30	4.18.1.4	1	1	... quality of the water in the lowermost part of the lower aquifer because...	49
				It is anticipated that the water immediately above the dissolution surface is the only part of the lower aquifer that would be affected.	
4-30	4.18.1.4	1	2	This potential impact would occur only after an area measuring 1000' x 1000' was developed and would be the result of cavity collapse.	38, 49, 70
				The conditions would stabilize after a certain period of time and would not "persist for the foreseeable future".	
4-30	4.18.1.5	3	1	What is the BLM referring to when they state "water contamination"?	
				The water would have a slightly higher TDS value.	14
				The areal extant of the affected lands is not anticipated to be very large.	

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
4-31	4.18.1.11	2	1	Commercial-scale sodium development might adversely influence a small area for the development....	18
				The surface disturbance of the commercial-scale sodium project is anticipated to be minimal.	
4-31	4.18.2.2	1	3	... quality of the water immediately above the dissolution surface in the lower aquifer...	49
				The lowermost part of the lower aquifer is the only part of the hydrologic section which would be affected.	
4-31	4.18.2.2	1	4	This potential impact would occur after mining had developed an area 1000' x 1000'.	38
				It is not anticipated that these conditions would persist for the foreseeable future since conditions would stabilize over a period of time.	49 70
4-32	4.18.2.10	1	1	... activities in and around the area may shift to...	49
				It is not known if recreational activities would definitely shift to other areas.	
4-32	4.18.3.2	1	2	... quality of the water immediately above the dissolution surface in the lowermost part of the lower aquifer because of the amount...	49 70
4-32	4.18.3.2	1	3	The conditions would stabilize	

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				over a period of time and would not persist for the foreseeable future.
4-32	4.18.3.2	1	3	... the foreseeable future. It should be noted that the water quality just where the dissolution surface in the lower aquifer is already very poor (by natural processes) and has both high TDS and conductivity values. The solutions would be maintained in the lowermost part of the lower aquifer just where the dissolution surface, due to the density and viscosity differences of the fluid in the lower aquifer as well as the localized basin configuration of the dissolution surface. 49, 70
4-32	4.18.3.5	1	1	Potential destruction of the ... It is not known if the resources would definitely be destroyed. 10
4-32	4.18.3.6	1	1	Potential destruction of nonrenewable... It is not known if the resources would definitely be destroyed.
6.4-7	Rock Mechanics Ground Water Hydrology	2	2	The two aquifers are NOT separated by the Mahogany zone. The lower half of the Mahogany zone produces the majority of the water for the lower aquifer. The Mahogany bed acts as a leaky semi-confining horizon. 56, 60, 71
6.4-7	Rock Mechanics Ground Water Hydrology	2	3	... than surrounding rock and allows less communication between aquifers than the rocks above or 61, 71

2-25

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Pg. #	Heading	Prgh. #	Sent. #	Comments
				below the upper Mahogany zone. 61, 71
6.4-7	Rock Mechanics Ground Water Hydrology	2	4	... sodium minerals in the intervals from the L-S through the R-S zone (leached zone) have caused ... 49, 71 In the lease area the leached zone extends from the middle of the L-S zone through to near the top of the R-S zone.
6.4-7	Rock Mechanics Ground Water Hydrology	3	1	In some parts of the lease the base of the lower aquifer... 56, 60, 71
6.4-8	Figure 10			The lower aquifer should be extended at least half way into the Mahogany zone. The leaky semi-confining interval is the upper most part of the Mahogany zone. The leached zone extends from the dissolution surface up section through to near the top of the R-S zone (see Daub, Weston, and Roser, 1985). The Boies Bed is the lowermost member of the upper salt. Other saline oil shale horizons occur above the Boies bed. 43, 71
6.4-8	Rock Mechanics Ground Water Hydrology	5	1	... subsidence of strata immediately overlying the cavity and could affect the integrity or quality of the lower aquifer immediately above the dissolution surface. 40, 49, 71 The rock quality from 10-15' above the dissolution surface through the lower Mahogany zone is already very poor. It is anticipated that the ground water immediately above

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
				the dissolution surface is the only part of the lower aquifer which would be effected.	40, 49, 71
6.4-8	Rock Mechanics Ground Water Hydrology	6	2	... will be such that plastic flow of nahcolite at the tops of the pillars...	49, 71
2-26				It is anticipated that the nahcolite will respond to loading in a plastic flow.	
6.4-8	Rock Mechanics Ground Water Hydrology	8	1	Impacts to the lowermost part of the lower aquifer water...	
6.4-8	Rock Mechanics Ground Water Hydrology	8	2	... communication between the water of the lowermost part of the lower aquifer...	
				The water in the lowermost part of the lower aquifer is not relatively fresh.	
6.4-8	Rock Mechanics Ground Water Hydrology	9	1	... isolated from the fresher water as the denser more viscous brines should remain ponded in the cavities with the lighter, less viscous fresher water ...	56, 71
6.4-9	Rock Mechanics Ground Water Hydrology	13	2	It is inconceivable to have turbulent flow at the base of the lower aquifer with the porosity and permeabilities which exist. Fluids will take the path of least resistance and may stay entirely below the dissolution surface due to the confining beds. There are no subsurface rivers or lakes that exist in which turbulent flow could occur.	

11

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Pg. #	Heading	Prgh. #	Sent. #	Comments	
6.4-9	Rock Mechanics Ground Water Hydrology	13	3	The result of an unlikely catastrophic roof collapse would be some mixing of the lowermost part of the lower aquifer ground water system with the cavity fluids. Cavity brines would contain fluid with a TDS value of up to 100,000 mg/l.	56, 71
				Water at the dissolution surface is not relatively fresh and thorough mixing is not anticipated due to the density and viscosity differences of the fluids. TDS values of the cavities will be on the order of 100,000 mg/l not 140,000 mg/l.	
6.4-9	Endemic Colorado River Fishes	4	2	Is Yellow Creek a perennial stream?	71, 72
6.4-9	Endemic Colorado River Fishes	8	3	This could accelerate the ...	
				It is not definitely known if the situation would accelerate the process.	71, 73
6.4-11	Long-Billed Curlew and White-Faced Ibis	5	3	On what are the "dry years" figures based?	
				How were the 70-80% reductions calculated?	
				On what numbers were these calculations based?	68, 71, 74
				See page 4-19, 4.9.3, 4, 3 which refers to the revised water consumption values.	
8-2	References			Wright Water Engineers, Inc. and Daub & Associates.	49

11

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Pg. #	Heading	Prob. #	Sent. #	Comments
2-37	Table 2-2	Total Acreage		The total acreage potentially disturbed over the life of the mine for the various alternatives are listed throughout the draft EIS. The acreage would probably not all be disturbed. Under the 125,000 TPY alternative, only 175 acres would be disturbed. Under the 50,000 TPY alternative, only 88 acres would be disturbed. Under the 500,000 TPY alternative, only 679 acres would be disturbed.
4-14	4.5	Table 4-4		
4-14	4.6	5	1	
4-15	4.6	Table 4-5		
4-15	4.6	6	1	
4-16	4.8	2	2	
4-31	4.18.2.4	1	1	
4-33	4.18.4.3	1	1	

48

2-27

11

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GENERAL COMMENTS

Aquifer Communication

It must be understood that the aquifers, as they exist today, beneath the WRC's sodium leases are in communication. Copious quantities of information including reports, documents, letters and published data supporting these facts have been supplied to the BLM. The Wright Water Engineers and Daub & Associates, 1985 report entitled, "Evaluation of the Hydrologic Connection Between the Upper and Lower Bedrock Aquifers and the Results of a Numerical Ground Water Model Study Piceance Creek Basin, Colorado" explains the present aquifer communication and contains 30 selected references which support the report.

Natural dissolution of abundant saline minerals in the L-5, R-6, Mahogany and R-8 zones as well as the A and B Grooves has left the rock very fractured and less competent. The voids left by the former saline minerals and associated fractures have provided a natural hydrologic conduit between the so called upper and lower aquifer systems in the depositional center of the Piceance Creek Basin beneath WRC's sodium leases.

55, 56, 60

Hydraulic head differences between the 2 major aquifer systems range from 1-10 feet on the lease, most measurements indicate less than a 5 foot head difference. These measurements indicate a hydraulic connection between the aquifers. There are no indications that there is a 100 foot head difference between the aquifers on the lease which is stated in the Draft EIS.

On the WRC sodium leases, the lower half of the Mahogany zone produces the majority of the water for the so called lower aquifer. This fact has been known since 1981 when the Multi Mineral Corporation conducted a detailed aquifer pump test on the sodium leases and is illustrated in Daub, Weston and Rosar's 1985 Colorado School Of Mines paper.

Due to the very poor rock quality and water production in the Mahogany zone it can not be considered a confining horizon. The only section which could act as a leaky semi-confining layer is the Mahogany bed itself which is 7-8' thick.

Leached Zone

The stratigraphic section between the dissolution surface and near the top of the R-8 zone should be referred to as the leached zone (Daub, Weston and Rosar, 1985). This also includes the entire Mahogany zone.

44, 49

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Drill Hole Completion

Production wells will be on line or active for approximately 90 days which is a relatively short period of time.

The cementing and completion procedures proposed by the WRC are more than adequate to effectively seal and support the wall casing during the life of the producing well. The use of a competent casing pack above the cement will allow the reuse of the 8 5/8" casing and protect the aquifers.

The 100 feet of cement at the base of the casing will support the casing and seal the annulus from the production cavity.

The BLM's proposed completion methods could easily lead to very expensive and costly cement squeeze jobs in order to meet the ultra conservative cementing stipulations or requirements which call for annular cement from the base of the casing up above the A-Groove.

2-28

Mining solutions will be contained inside the 5 1/2" casing as well as the 8 5/8" casing.

83

Production Well Abandonment

Production well abandonment is very much dependent on the method of the drill hole completion procedures. A bridge plug would be placed at the base of the casing.

WRC is proposing to cut and remove the 8 5/8" casing just above the 100 foot column of annular cement.

A 149 foot cement plug would be placed above the bridge plug to seal the production cavity and properly abandon the lower portion of the well.

Plugging gel would be located between the top of the bottom cement plug and the base of the surface plug at 65 feet. These set of procedures would adequately seal the well bore and prevent vertical movement of ground water.

The use of plugging gel will accomodate any ground movement whereas cement will not.

Ground Water Monitoring

There is no need to monitor the aquifer system of the B-Groove. 27, 30, 56

11

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Any potential effects on the aquifer system would most likely take place at the lowermost part of the lower aquifer, immediately above the dissolution surface. 27, 30, 56

The lowermost part of the lower aquifer is the only interval which would need to be monitored.

Geohydrologic Conditions

The natural geohydrologic process of the dissolution of the saline minerals is occurring today and has been occurring for probably millions of years. 56, 60

Beneficial Uses

The beneficial environmental effects of the uses of nahcolite including a dry-flue gas desulfurization agent far outweigh any minimal effects the mining process will have on the central Piceance Creek Basin geohydrologic system. 19

12

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
WGS-Mail Stop 423

SEP 22 1986

Memorandum

To: Bureau of Land Management, White River Resource Area, Meeker, Colorado

From: Assistant Director for Engineering Geology

Subject: Review of draft environmental statement for Wolf Ridge Corporation, mine plan for a nahcolite solution mine, Rio Blanco County, Colorado

2-29

We have reviewed the statement as requested in a letter included in the draft document.

Page 3-12 states, "The two bedrock aquifers are generally confined or artesian. This means that the water level of a well in the water-bearing zones will be higher than the water table." This points to a need for a better explanation of the hydrologic system of the project site. Do water-table conditions indeed exist beneath the upland site? The zonation of the upper aquifer should then be discussed. If, however, the meaning of the statement in question is that the water level in a well penetrating one of the confined aquifers will be higher than the base of the upper confining layer, the statement should be reworded. If indeed the piezometric surface in both the upper aquifer and the lower aquifer is above the water table in an unconfined shallower aquifer, this should be significant in evaluating the potential for and the direction of quality-of-water impacts. 60

The basis for the conclusion that in the project site, hydraulic head differences between the upper and lower aquifers range from 1 to 10 feet (p. 3-12) should be explained. This factor may be especially important in considering the possibility of impacts from the proposed mining on both ground-water quality and on the integrity of the Mahogany Zone. Unpublished data from U.S. Geological Survey (USGS) tests on both aquifers in four wells located a few miles from the site indicated differences in head of 4, 7, 9 and 12 feet (Van Liew, William P., Oral communication, September 19, 1986). The evaluation of the significance of the head differences between the upper and lower aquifers should include consideration of the similarity in elevations of recharge for the two aquifers and the location of the mining site on the flank of the basin with respect to the recharge areas. The evaluation should also incorporate consideration of the significance of differences in water 60, 75

12

quality of the upper and lower aquifers. For example, the fluoride concentrations measured by the USGS a few miles from the proposed solution mine site were 0.4 mg/l in the upper aquifer and 22 mg/l in the lower aquifer, a very significant difference suggesting very little mixing of waters of the two aquifers under prevailing conditions (Van Liew, William P., Oral communication, September 19, 1986; Tobin, Robert L., Oral communication, September 17, 1986). 60, 75

What mitigation, if any, would be possible if effects of fracturing and roof collapse should--contrary to expectations--extend upward into the Mahogany Zone? The paragraphs on ground-water monitoring (p. 2-8, 2-13) outline proposed monitoring of piezometric head and quality of water in the lower aquifer. However, adequate monitoring should also include both piezometric head and quality of water in at least the lower part of the upper aquifer. USGS analyses indicate that the present ground-water quality in the upper aquifer will satisfy U.S. Environmental Protection Agency, 1976 and U.S. Public Health Service, 1962 drinking water criteria (Van Liew, William P., Oral communication, September 19, 1986; Tobin, Robert L., Oral communication, September 17, 1986). The statement should assess potential ultimate effects on the hydrologic system from project-related changes in the quality of water in the lower aquifer, if the head in the aquifer is increased as a result of mining activities. If there is at present an appreciable degree of hydraulic continuity between the upper and lower aquifers at the site, or if permeability of the Mahogany Zone should be increased by mining activities or subsidence stresses, the potential for upward migration of poor quality water into the upper aquifer would be increased. This possibility should be included in the assessment. Planned surface injection pressures and anticipated discharge pressures should be discussed to aid in this assessment. Calculated subsidence at the level of the Mahogany Zone should be included. Page 3-12 states that the flow of ground water in the lower aquifer is toward a sink located in the northwestern portion of the lease area. The ultimate fate of this flow should be considered. Figure 3-2 and work by previous investigators1/ indicate that the movement of ground water from the lower aquifer is ultimately upward to Piceance Creek and tributaries. The long-term effects of mining on the lower aquifer should be assessed in terms of the ultimate destination of the flow of the aquifer. 27, 56, 80, 81; 56, 60, 76; 56, 60

James F. Devine

1/ (a) Van Liew, William P., Oral communication, September 19, 1986
(b) Weeks, John B., 1976, Digital Model of ground-water flow in the Piceance Basin, Rio Blanco and Garfield Counties, Colorado: U.S. Geological Survey Water-Resources Investigations Report 78-46.
(c) Weeks, John B., 1974, Simulated effects of oil shale development: U.S. Geological Survey Professional Paper 908.

Copy to: District Chief, WRD, Lakewood, Colorado

13

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ONE DENVER PLACE — 999 18TH STREET — SUITE 1300
DENVER, COLORADO 80202-2413

Ref: 8PM-EA

Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P.O. Box 928
Meeker, Colorado 81641

SEP 23 1986

Dear Mr. Frank:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA), Section 309 of the Clean Air Act, and Part C of the Safe Drinking Water Act, the Region VIII Office of the Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement for the Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine. Our detailed comments are attached for your consideration on this unique mining operation.

2-30

EPA's principal concerns are that the analysis of impacts to the ground and surface waters needs to be improved, specific construction and operational features of the proposal require further refinement especially regarding injection well abandonment, and that BLM's final EIS analysis regarding groundwater protection should be coordinated with EPA's proposed issuance of a Class III underground injection well permit for the proposed activity. We believe we can accomplish these goals jointly with the cooperative approach displayed by your office and look forward to a mutually beneficial process eventually leading to regulatory compliance for the proposed action or an alternative to the proposed action consistent with BLM and EPA statutory mandates.

According to the procedures EPA uses to rate the adequacy of a draft EIS, the Draft EIS for the Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine will be listed in the Federal Register in Category EC-2 meaning we have environmental concerns with the proposed action regarding ground and surface water protection and that additional information is recommended regarding the specific items noted in the detailed comments. Please contact Mr. Weston Wilson at 303/293-1703 or Mr. Marc Herman at 303/293-1442 regarding the preparation of EPA's Class III permit and the BLM Final EIS.

Sincerely,

Dale Vodehnal, Chief
Environmental Assessment Branch

Enclosure

cc: William Dickerson, EPA, Washington, D.C.
Bob Stewart, Department of the Interior, Denver
Ed Rosar, Industrial Resources, Inc.

13

DETAILED COMMENTS BY THE
U.S. ENVIRONMENTAL PROTECTION AGENCY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
WOLF RIDGE CORPORATION MINE PLAN
FOR A NAHCOLITE SOLUTION MINE

General Comments on the EIS Process and EPA's UIC permit authority

The following comments reflect EPA's concerns with the analysis of the possible impacts of the proposed action on the Piceance Basins aquifers and their associated surface waters. EPA appreciates that BLM was able to include in the EIS the analysis of the proposed action and the UIC program (Appendix F). The issues identified by EPA in that brief analysis have yet to be resolved by the agency and the applicant. We expect that the process of information exchange and discussion of alternative means of well completion, abandonment and monitoring will continue between our agencies and the applicant and that the result of these deliberations can be summarized in the EIS.

According to the applicant, EPA will receive the application for the Underground Injection Control (UIC) permit for the proposed action by the end of October, 1986. EPA anticipates it will take approximately six months from receipt of a complete application until EPA issues a draft Class III UIC Permit. This means that the current EPA schedule for issuance of a draft UIC permit would be April, 1987. According to discussions with BLM staff, your office now plans to issue the final EIS by March, 1987. We request that our respective staff meet and discuss the following concerns at your earliest convenience. During this session we can address a joint Final EIS and draft UIC permit process to help resolve any informational gaps and any possible conflicting regulatory aspects of the proposed action.

EPA strongly suggests that several cross sections be developed to show the details of the applicant's well construction and abandonment of production and injection wells. In addition, similar cross sections are needed to depict the alternative mitigation methods for completion and abandonment and alternative means and locations of monitoring the proposed solution mining. Development of these cross sections will aid greatly in the upcoming discussions between our agencies and the applicant.

Specific Comments on the draft EIS

p. 1-1 The purpose and need for the proposed action is limited to a description of the production of the sodium bicarbonate product. A brief discription of the product use and its alternative use, as suggested by the applicant, as a flue gas desulfurization agent could be included in the final EIS. — 20, 49

p. 2-3 The applicant proposes to use a chemical gel-type mud between the 8 5/8 inch casing and the drill hole and later for sealing the drill hole. What evidence can be provided from the pilot project or other sources that this mud will stay in place? — 83, 86

p. 2-4 Solid removal from the evaporation ponds could risk puncture of the 20 mil Hypalon liner. What method will be used to remove solids to assure protection of the liner's integrity? — 54

p. 2-8 The use of former production wells as monitoring wells appears practical and could be effective. The EIS should further describe how this will be done. EPA suggests that consideration be given to using these wells to monitor the lower aquifer and possibly within the solution cavities themselves. There needs to be further indication of the method proposed for monitoring the integrity of the mud between the 12 1/4 inch borehole and the 8 5/8 inch casing. The document indicates that the applicant would report water quality monitoring on a yearly basis to EPA. EPA regulations for injection for the purpose of mineral extraction (class III wells) require reporting on a quarterly basis [40 CFR 146.33 (c)]. — 27, 28, 29, 49, 56

p. 2-8 The applicant proposes to assure mechanical integrity of the injection wells by pressuring up the annular space between the 8-5/8 inch casing and the 5-1/2 inch production pipe, using air. The pressure will be maintained at 800 psi gauge. If the pressure drops below 700 psi, the well will be taken out of service. The proposed plan may not be adequate to assure that brine will not move into the annular space. Assuming that the brine has a density of 1.2, the production well will have a pressure of about 1000 psi at the base of the 1900 foot casing. This would allow brine to extend into the annular space about 375 feet. This point is above the B-Groove. If the air pressure at the surface dropped to 700 psi, the brine column would extend up the annular space to a point above the A-Groove. — 87

p. 2-8 The section on the applicant's monitoring for mechanical intergrity of the wells does not address potential fluid movement through channels adjacent to the well bore. Such a determination must be made, according to UIC regulations, prior to commencement of injection. Two methods, which are approved of by EPA under the UIC program, are noise logs and temperature logs [40 CFR 146.9(3)(c)]. — 88

p. 2-8 Additional details are needed on the multiple point borehole extensometer design and installation. Why are surface monuments installed to check for subsidence but not within first 1300 feet of the surface? The subsidence monitoring program may not accomplish its objective of determining the extent of rock fracturing (and hence aquifer interconnection) between the solution cavities and the surface unless additional monuments are established. — 46

p. 2-9 How will the applicant assure and monitor the rib pillar dimension of 20 feet? Strength tests have been run on the nahcolite material and should be summarized here. — 39

2-31

p. 2-17 An illustration would be helpful showing how the project will develop including plan and cross sectional views of the solution cavities. A plan view of the cavities and well fields as they relate to the location and flow patterns of groundwater resources would also be useful. — 82

p. 2-24 The mitigation proposed by BLM in section 2.4 does not adequately address the potential for brine movement into the annular space. EPA may require the applicant to modify its plan for mechanical integrity to hold sufficient air pressure at the surface to maintain the liquid/air interface in the annular space below the dissolution surface. EPA now is of the opinion that the surface pressure criteria for shutting a well in needs to be established such that the liquid/air interface does not extend above the base of the R-6 zone. — 87

p. 2-25 It is noted that considerable additional air quality controls may be necessary for the 500,000 TPY alternative. Presumably such measures would be needed by the applicant to assure compliance with the Class II air quality increments under the Clean Air Act. Additional air quality control measures may also become necessary for the proposed action if EPA concluded from its current western states acid deposition investigations that additional sulfur and nitrogen oxide controls are necessary to assure protection of the air quality related values of PSD Class I areas. A brief mention of EPA's current acid deposition investigation should be included in the final EIS and deference to the State of Colorado and EPA in implementing possible further controls on sulfur and nitrogen oxides noted accordingly. (Note: The Colorado Department of Health, Air Quality Control Division, received partial delegation from EPA for the PSD program on September 9, 1986.) — 2, 3

p. 2-35 The EIS concludes that under the proposed action groundwater quality could not be significantly impacted by direct contamination partly because the area of the base of the groundwater system in contact with the mine represents only one percent of the total area of the aquifer system in the Piceance Basin. It is possible that active dissolution of nacholite is occurring over a smaller portion of the basin rather than, as suggested, the entire basin. If so, then the increased dissolution as a result of this action could produce an impact on groundwater quality different from the areal proportional relationship. — 56, 77

p. 3-12 Based upon a report by Wright Water Engineers, the EIS indicates that the hydraulic head difference in the well field area is from 1 to 10 feet. It needs to be established that the well completions showing this difference in head were such that the upper and lower zones were completely isolated when the head differences were measured. — 55, 78

p. 3-12 What is meant by, "Flow in the lower aquifer is towards a sink" and the "characteristics of any flow out of this sink are unknown"? As Figure 3-2 and Page 3-9 note, there is flow out of the lower aquifer with discharges to Piceance and Yellow Creek. This appears consistent with EPA's understanding of the regional hydrogeology. We suggest that these references to a ground water "sink" be deleted from the final EIS since they appear to conflict with the other conclusions about the discharge of flow from the Basin. 60

p. 3-13 The human health standard for fluoride concentration in drinking water established by EPA under the Safe Drinking Water Act has been recently changed to 4.0 mg/liter.

p. 4-4 The EIS correctly notes that as a result of the prediction for exceeding the 24-hour particulate concentration of the Class II PSD increments, the applicant would either have to: 1) use a different, less conservative, model, 2) reduce the emission estimates appropriately, or 3) provide additional controls to assure compliance with the Class II increment standards. Due to the predicted violation of PSD Class II increments, EPA concludes that the alternative of 500,000 TPY is unacceptable until this issue is resolved. However, note that since the Nation's current output of sodium bicarbonate is less than that produced under this alternative, we suggest that this alternative be dropped from further analysis. If this alternative is to be retained in the analysis, the applicant's opinion of market expansion that would make this a plausible alternative should be included in the final EIS. 4

p. 4-11 The conclusion by Weston (1985) that subsidence could cause a mixing of the upper and lower aquifers requires much additional attention. The EIS could present a more thorough evaluation of the quantity of salt that could enter the groundwater system from the solution cavities each year. Diffusion rates (including temperature effects) groundwater flow rates, saturated salt content of the brine-filled cavities, and the effect of cavity collapse and subsidence fractures on groundwater flow rates, could be evaluated to predict the amount of salt moved from the cavities into the groundwater system and the eventual, if any, impact on surface water quality. EPA suggests that consideration be given to the development of a hydrologic model to evualate such an eventuality using the data obtained from the pilot project. 56, 79

p. 4-12 EPA suggests that consideration be given to separate wells, or isolated multiple completion wells, to monitor the Uinta aquifer, the upper Mahogany aquifer, the lower Mahogany aquifer, and the zone above the dissolution surface to better detect brine leaks. 27, 56

p. 4-13 The proposal to inject fly ash into the cavities is interesting and could become beneficial. What are the leaching characteristics of this fly ash? 16

p. 4-25 The effectiveness of the "rubber beds" in sealing small cracks is questionable, especially if under tension. The statement on Page 4-12 that "the applicant believes that the likelihood of establishing a physical connection between the mine zone and the groundwater system would be low because of rubber beds and competent oil shale" needs to be verified by monitoring, if possible, during the pilot phase. 42, 56

p. 6.6-2 At the top of the second column, it should refer to "overlying a Class III mine zone" rather than Class II. 49

p. 8-2 Is the "Wheatcraft, et. al." reference utilized in the EIS regarding the potential change in groundwater flow as a result of subsidence? 21

14

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
2060 ADMINISTRATION BUILDING
1745 WEST 1700 SOUTH
SALT LAKE CITY, UTAH 84104-5110

IN REPLY REFER TO:

September 23, 1986

MEMORANDUM

TO: Willy Frank, Project Coordinator, Bureau of Land Management, White River Resource Area, Meeker, Colorado

FROM: Robert L. McCue, Field Supervisor, Ecological Services, U.S. Fish and Wildlife Service, Salt Lake City, Utah

SUBJECT: Draft Environmental Impact Statement (OEIS) Wolf Ridge Corporation Mine Plan for a Nahcolite Solution Mine (EC #86/30)

2-33

The U.S. Fish and Wildlife Service has reviewed the subject OEIS and offers the following comments. Our Endangered Species Office has been in contact with the BLM regarding section 7 consultation, therefore, this memo will not address endangered species concerns.

Of the four alternatives presented, the No Action Alternative is preferred by our agency. However, we view the proposed action as a reasonable compromise that allows development yet includes stipulations that reduce fish and wildlife impacts.

SPECIFIC COMMENTS

Page 2-29, 2.2.13. Other Applicant Proposed Mitigation
Point 11 mentions that all powerlines will be constructed in accordance with standards established in USDA REA Bulletin 61-10. In addition to this document, the Service recommends that guidelines presented in "Suggested Practices for Raptor Protection on Powerlines - State of the Art in 1981" (Raptor Research Report No. 4, Raptor Research Foundation, Carpenter St. Croix Nature Center, 12805 St. Croix Trail, Hastings, Minnesota 55033) be followed as well. — 89, 90

Page 3-19, 3.6.5
The Nature Conservancy has nominated an area encompassing the project site for designation as an area of critical environmental concern (ACEC). A detailed explanation of why the Nature Conservancy nominated this area and why BLM rejected their proposal should be included in this section of the DEIS. — 8

Page 3-19, 3.8. Wildlife
A list of wildlife species in the project area should be included in an appendix. — 91

14

Page 3-20, 3.8.1. Big Game
All proposed alternatives overlay mule deer severe winter range habitat. This is the most critical habitat for mule deer during a severe winter and probably has the greatest effect on limiting the local deer herd. We question whether the mitigation proposed will be able to compensate for this loss. — 92

Page 3-20, 3.8.2. Raptors
A more detailed description of data collected should be presented. Dates, times, duration and methods of raptor surveys should be included in an appendix. Is the available data adequate to support conclusions in section 4.9.2? — 93

Page 3-23, 3.8.6. Aquatic, Wetland, and Riparian Habitats
What definition was used to determine wetland habitat? The Service requests wetlands be defined according to "Classification of Wetlands and Deepwater Habitats of the United States", Cowardin, et. al., December, 1979, FWS/OBS-79/31 (Service Administrative Manual 30AM 10.0). — 5

Page 4-10, 4.4.2. Surface Water Quality
What impacts will degraded surface water quality have on aquatic and terrestrial habitats in lower Yellow Creek? — 6, 49

Page 4-15, 4.6.1. Threatened, Endangered, Candidate, and Sensitive Plant Species and Remnant Vegetation Associations
How will the 45 acres of remnant vegetation association (RVA), identified by the Nature Conservancy, be affected by the proposed alternative (125,000 TPY)? — 51

Page 4-18, 4.9.2. Raptors
This section states "available information indicates that the entire project area supports very little raptor nesting activity", yet it is unclear how much information is available, and if the available data is adequate to draw this conclusion. — 93

Page 4-19, 4.9.3. Upland Game and Waterfowl
This section states "during dry years groundwater use in the 125,000 TPY Alternative (preferred alternative) might reduce average summer flows in lower Yellow Creek by 20 to 40 percent". How would these flow reductions effect the aquatic, wetland, and riparian habitats on lower Yellow Creek, and how would non-game species be affected? These habitats are of high resource value, therefore, the Service requests mitigation for any loss of habitat values. — 7, 49

Page 4-20, 4.9.6. Aquatic, Wetland, and Riparian Habitats
This section states that the 500,000 TPY Alternative would induce notable flow reduction in lower Yellow Creek; even periodic drying of the channel. Because of the anticipated loss of aquatic, wetland and riparian habitat values, the Service cannot support this alternative.

14

The Service appreciates the opportunity to comment on this draft EIS. If you have any questions regarding these comments, please contact Jeff Opdycke of our Grand Junction Office.

Sincerely,

Robert L. McCue
Field Supervisor

cc: FWS/ES, Grand Junction
FWS/HR, Denver
FWS/SE, Grand Junction
FWS/ES/BEC, Washington, D.C.
CDOW, Grand Junction

2-34

15

COLORADO HISTORICAL SOCIETY

Colorado State Museum 1300 Broadway Denver, Colorado 80203

September 25, 1986

Willy Frank, Project Coordinator
Bureau of Land Management
White River Resource Area
P. O. Box 928
Meeker, CO 81641

RE: Wolf Ridge Corporation Mine Plan - Nahcolite Solution Mine

Dear Mr. Frank:

This office has reviewed the draft environmental statement for the above proposed project.

It is our understanding that most of the lease areas have been inventoried for cultural resources. Those areas that have not been inventoried must be surveyed prior to any construction activities.

When the extent of the project and the area of impact is known, determinations of eligibility and effect must be completed by the Bureau of Land Management in consultation with this office. 11

Please note that consultation with the State Historic Preservation Officer must occur whether or not known and identified cultural resources can be avoided by project design. We also anticipate consultation regarding properties discovered during ground disturbing activities. (See 2.3.1.7.8. and 2.4.1.1.9.)

Tables 3-5 and 4-8 are not consistent. They appear to be listing the cultural resources affected by all the alternatives. These tables should be checked and corrected if needed or a better explanation should accompany them. 49

If this office can be of further assistance please contact Jim Green at 866-3392.

Sincerely,

Leslie E. Wildesen
Deputy State Historic Preservation Officer

LEW/WJG:jc

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United States Department of Agriculture | Forest Service | Rocky Mountain Region | 11177 W. 8th Avenue Box 25127 Lakewood, CO 80225

Reply to: 2800
1950

Date: September 26, 1986

PUBLIC HEARING

WOLF RIDGE CORPORATION MINE PLAN
HANCOLITE SOLUTION MINE

BUREAU OF LAND MANAGEMENT

Bureau of Land Management
Colorado State Office
2850 Youngfield Street
Lakewood, CO 80215

Dear Sir:

The proposed Wolf Ridge Corp. Mine is 25 to 30 miles west of the nearest National Forest Service Unit. There is no effect or impact expected on National Forest Service lands or programs

We have no comments on the proposal.

CHARLES J. HENDRICKS
Director, Watershed, Soils, and
Minerals Area Management

cc: WO
PPB

WMR:ls

BODEWAY INN
2790 CROSSROADS BLVD
GRAND JUNCTION, COLORADO

WEDNESDAY, AUGUST 27, 1986
7:00 p.m.

2-35

FS-6200-26(7-82)

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PROCEEDINGS

CURT SMITH: I guess we might as well get started, it is a little after seven, with the meeting. I'm Curt Smith, Resource Area Manager for the White River Resource Area in Meeker. I would like to welcome you all here this evening. Introduce the panel, Willy Frank, far right he's the project coordinator; Foster Beckett, he's technical coordinator for physical resources; Dave Nylander, he's the technical coordinator for biological sciences. Willy, I'll just turn it over to you and I'll sneak back in the back.

WILLY FRANK: Thanks Curt. I would like to welcome you all here and again my name is Willy Frank and I'm the project coordinator for Wolf Ridge Corporation development out in the Piceance Basin. First off I would like to let you know what the primary purpose of this meeting is. Basically, that is to allow you, the public the opportunity to comment on the adequacy of our environmental impact statement in which we analyze Wolf Ridge Corporation's proposal. I would like to stress that specific comments will not be answered tonight. This meeting is primary for comment solicitation. However, all substantive comments will be answered and addressed in the final environmental impact statement which should be out to the public sometime around March of next year.

We will be acting as a panel for those people who do comment tonight and primarily all we will be doing is questioning any commentors if comments need to be expanded upon for clarification purposes.

As far as rules and orders for taking oral comments, we have a list and we will be going down the list. And we would like to limit comments to a maximum of 10 minutes and we would appreciate a written synopsis of

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comments if possible. If you don't have a written synopsis with you, you can mail it in prior to the September 23 written comment deadline.

What I would like to do is to give you a little background on Wolf Ridge Corporation and their lease development.

Wolf Ridge Corporation holds the rights to four sodium leases out in the Piceance Basin. These lease were originally issued back in July of 1971. This is a general location map here and you can see this star in this red this is where the project development and the leases lie. This is Meeker here. Rifle is down here. Here's Rangely. This encompasses the Piceance Basin Planning Unit. Here's Oil Shale Tract C-a. The sodium leases are approximately 6 miles northeast of Oil Shale Tract C-a. They lie on Ber D Mesa which is an upland in between Yellow Creek and Piceance Creek in Piceance Basin.

WRC's initial lease development really kicked off in February of 1983 when they contracted Cliffs Engineering, Inc. out of Rifle to provide engineering designs and financial analyses for a commercial-scale development out in Piceance Basin for development of their leases. The result was development of a three-phase plan to bring the project into commercial development. First phase was a 3-ton/day bulk sampling operation which ran from November 1983 to February 1984. They produced an excess of 165 tons of sodium bicarbonate. The second phase involves construction and operation of a 6 tons/hour pilot scale mine. It was originally approved by BLM in February of 1984. No development took place. In the summer of 1985, Wolf Ridge Corporation came in with some revisions to their approved mine plan and we subsequently analyzed and approved the proposal for the pilot project in an environmental assessment which was approved in May of this year. The third phase is the Proposed Action (125,000 tpy) commercial-scale nahcolite solution mine which is the impetus behind this environmental impact statement. They

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submitted the proposal for the commercial-scale project on October 9, 1984. Initial internal screening indicated it represented a major federal action with the potential for significant impacts. Therefore, pursuant to the National Environmental Policy Act of 1969, an environmental impact statement was required in conjunction with approval of their mine plan.

The purpose of the EIS is to analyze and define the potential environmental and socioeconomic impacts of their proposal and a range of reasonable alternatives. In addition, it's intended to identify the stipulations and special mitigation measures that need to be applied in an effort to minimize or alleviate potential impacts.

There were four alternatives that we analyzed in the environmental impact statement. In addition to their 125,000 tpy proposal, we analyzed two other commercial-scale alternatives -- a 50,000 TPY and a 500,000 TPY Alternative. In addition, we analyzed the No Action Alternative, which involves their pilot plant project. It's important to understand that the No Action Alternative does involves the pilot plant project and the reason behind why it does, is that this was a separate mine plan that was submitted in the past. It is a seperate action and will occur regardless of the outcome of our environmental impact statement on their commercial scale facility.

As far as the proposed action, again it's a 125,000 tpy, 30-year project. Plans call for a phased approach development starting off at 50,000 tpy for the first couple of years. The second or third year of operation they plan to escalate to 125,000 tpy for the remainder of the 30 year project life.

Some of the facilities involved include a well field for in situ solution mining of nahcolite; the red here would be the processing plant facilities; blue represents evaporation ponds which would be utilized for waste water disposal; and the green represents topsoil stockpiles.

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Some of the other major feetures. They would be utilizing neturel gas as a power source under their proposal. They would be bringing in weter from e well located in section 24 on which they have water rights.

As fer es the impacts go, under the No Action Alternative and the 50,000 TPY Alternative there would be no potentlelly signlficant adverse impacts to the environment. The only potentially signiflcant impacts associated with the commerciel scale development would be to groundweter quantity end quelity. As fer as groundwater quentity, es e result of the consumptive use of their operation we anticipate up to a 5 percent reduction in averege deily flow of Yellow Creek. However, this would be mitigated by a state required weter augmentation plan.

As fer es weter quelity, due to potentiel subsidence, the area at the base of the lower Green River aquifer. I don't know if all of you cen see this map or not. It shows the lower aquifer here. The base is commonly referred to as the dissolution surface. The base of the lower aquifer would be in increased contact with selt due to potentiel subsidence that would increase the eree of the lower equifer by about 20 percent within leese tract erea. We consider this potentially significant locelly, but from e regionel stand point we do not feel this is a significant impect.

The environmentally preferred elternative is the No Actlon Alternative and the BLM preferred elternetive is the Proposed Actlon (125,000 TPY Alternetive).

I know thet's a reel quick overview but I would like to go shead and jump into the oral comments portion at this time. And I would like to remind you that you are being teped. As I read off your neme if you could please stand up and again stete your neme and your affiliation and go shead and make your testimony. Martin Jones.

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MARTIN JONES: Do you want us to talk by the microphone?

WILLY FRANK: No you can stand right there and I will pick you fine, Martin.

MARTIN JONES: Okay. My name is Martin Jones and tonight I am providing a few comments on behalf of Wolf Ridge Corporation -- the proponent of the nahcolite solution mining project.

My brief comments deal specifically with the Bureau of Lend Menegement's imposition of overly restrictive stipuletions concerning well completion end ebandonment. These stipulations appear on page 2-13 in regard to the pilot mining project end on peges 2-24 and 2-25 in regard to the proposed commercial scele project. At issue, specificelly, is our proposed use of gel plugging mud versus BLM's requirement to use cement in well completion and ebandonment.

Wolf Ridge Corporetion is currently in the process of appealing these stipuletions to permit the opportunity to demonstrate the feesibility of our proposed methods within the context of the pilot mining project, before we proceed to commercial development. BLM's stence on this issue to date has been to deny Wolf Ridge the opportunity to demonstrete its methods until presumably some future date when commercial operations ere underway. We feel the most appropriate context in which this demonstretion should occur is under the pilot mining project which is designed for technology demonstration and extra efforts can be directed toward monitoring rather than during commercial operations when more emphasis is put on protecting one's investment.

If Wolf Ridge Corporetion is successful in its appeal and the completion and abandonment method is demonstrated to BLM's satisfaction during the pilot mining phase of the project, Wolf Ridge will request permission to use its proposed methods in the commercial phase of the operations.

That's all I have.

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WILLY FRANK: Bill Bellis.

BILL BELLIS: I'm Bill Bellis with Wright Water Engineers in Denver, representing the applicant's view point I suppose.

I have a few comments to make. The written portion of this will be submitted prior to that September 23 deadline but they will not be submitted at this point, at this time.

My comments are sort of generalized in some respects and one is I would like to point out that in the EIS in the written part of it there was a reference made to a 100-foot head difference between the lower and upper aquifer as designated on the diagram that you have up there. To my knowledge there is no measured 100-foot difference in the upper and lower aquifer by an actual measurement. I think maybe the 100-foot difference of head came from a report that we submitted that had a head map for the uppar and lower aquifer and it showed a 100-foot difference as a result of a computer run. But that was not an actual measurement, in other words it was simply a run that showed how similar the heads were taking into consideration all the available hydraulic information in running a transient calibration for the model run. So I don't think there is a 100-foot head difference measured, to my knowledge on the site. 56

Secondly, I would like to suggest that maybe there be more emphasis placed on the fact that there is hydraulic connection between the upper and lower aquifers. Our model runs which were done to show the effect of pumping to dewater in order to hypothetically mine the Mahogany oil shale zone and all the wells, hypothetical wells in the lower aquifer, using all the hydraulic data, that is the USGS data for the vertical leakage and so forth within the stratigraphic neutrus. We still then were able to dewater the upper aqulfer in the model run. So with this available information I think there is 55, 60

considerable weight that indicates there is a definite hydraulic connection. This, in connection with the core analysis, actual visual analysis of these cores, indicating rubble solution activity and so forth, adds again to this idea that there is hydraulic connection. In addition, there is the actual measurement of the head in some of the wells that show there is very small head difference in the order of 10 feet or less in some of the wells for the upper and lower aquifer. 55, 60

Another comment would be that there seem to be a considerable amount of emphasis for the catastrophic condition of turbulent flow if there were collapse in the lower aquifer. I think that, it is sort of indicated that maybe this was something that was likely to happen and would really cause a turbulent flow and a commingling of these high saline waters of the lower aquifer, or lower mine zone into the upper aquifer. But I think that this would be, if there were collapse, this would be on a very local scale and I can't foresee this being transmitted readily as turbulent flow into the upper aqulfer. 56

Those would be my comments. Thank you.

WILLY FRANK: Jerry Daub.

JERRY DAUB: I would like to thank you for the opportunity to comment on the draft EIS on the Wolf Ridge Corporation mine plan. I feel the BLM should be commended on their efforts.

The first issue I would like to address is the present aquifer communication between the water bearing horizons above the Mahogany Zone and below the Mahogany Zone. Site specific on the Wolf Ridge Corporation's sodium leases the lower half of the Mahogany Zone produces the majority of the water for the so called lower aquifer. This has been published in a number of different places. One of which was in the Colorado School of Mines' oil shale 44, 55, 56, 60

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symposiums paper that was presented and authored by Daub, Weston, and Rosar. Due to the very poor rock quality and water conduction in the Mahogany Zone, it can not be considered a confining horizon or layer. The only section which could act as a leaky, semiconfining layer is the Mahogany bed itself, perhaps that is in the order of 7 to 8 feet thick. The stratigraphic section between the dissolution surface and near the top of the R-8 Zone should be referred to as the leached zone. Again this was relating back to the Colorado School of Mines paper that was recently published. This leach zone then would include the entire R-6, Mahogany Zone, and well up into the R-8 Zone. Natural dissolution of abundance saline minerals in the R-6, Mahogany Zone, and the R-8 Zone has left the rock very fractured and incompetent. The voids left by the formal saline minerals and associated fractures have provided a natural hydraulic conduit between the so called upper and lower aquifer systems. 44, 55, 56, 60,

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Numerous reports, articles, and documents have been supplied to the BLM which indicate major water producing horizons are now in communication. Hydraulic head differences between the two aquifer systems range from 1 to 10 feet on the sodium lease, most of which indicate less than a 5-foot difference. The fact that these measurements are so small indicate a hydraulic connection between the aquifers and there are no indication that there is a 100-foot head difference between the aquifers on the lease, which is stated in the draft EIS. Spacial paper 908 of the U.S. Geological Survey also states that the aquifers are in hydraulic communication with one another. Water chemistry between the water above the Mahogany Zone and below the Mahogany Zone is very similar both in and around the lease area.

The next major issue I would like to address is the drill hole completion. The first being that the production well being on line or active for approximately 90 days, which is a relative short period of time. The 83

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cementing and completion procedure proposed by the Wolf Ridge Corporation are more then adequate to effectively seal and support the well casing during the life of the producing well. Use of a competent casing pack above the cement will allow the reuse of the 8 5/8-inch casing and protect the aquifers as well. The 100 feet of cement at the base of the casing will support the casing and seal the annulus from the production cavity. The BLM's proposed completion methods could easily lead to very expensive and costly cement squeeze jobs in order to meet the ultra conservative cementing stipulations or requirements which call for annular cement from the base of the casing up above the A-Grooves. Mining solutions will be contained inside the 5 1/2-inch casing as well as 8 5/8-inch casing, thus minimizing any potential leakage in any of the aquifer systems. 83

The next major topic is production well abandonment. The production well abandonment is very much dependent on the method of the drill hole completion procedures. A bridge plug will be placed at the base of the casing. WRC has proposed to cut and alleviate the 5/8-inch casing just above the 100-foot column of annular cement. At that point 149 feet of cement would plug the bottom of the drill hole. This would seal the production cavity and properly abandon the lower portion of the well. The competent plugging gel would be placed between the top of the bottom cement plug and the base of the surface water (65 feet). These set of procedures would adequately seal the well bore and prevent vertical moving of groundwater. The use of the plugging gels as abandon fluids will accommodate any ground movement, whereas cement may not.

Again WRC feels there is no need to monitor the aquifer system above the Mahogany Zone. Any potential effects on the aquifer system would most likely take place at the lower most part of the lower aquifer immediately 27, 56

above the dissolution surface. The lower most part of the lower aquifer is the only interval which should be monitored. The BLM refers to turbulent flow of fluid from collapse of solution mine cavities. It is inconceivable to have turbulant flow even with cavity collapse due to the low permeability in velocity values which exist. Fluids will take the path of the least resistance and may stay entirely below the dissolution surface due to confining beds. There are no major subsurface rivers or lakes that exist in which turbulant flow could occur. 27, 56

The BLM also refers to relatively fresh water in the lower aquifer. The water near the dissolution surface is not relatively fresh at all, but very saline. TDS values as high as 40,000 to 60,000 parts per million have been measured across this interval. The affects to the aquifer system from cavity collapse would be confined to the lower most part of the lower aquifer immediately above the dissolution surface. Any adverse affects from cavity fluid escaping into the lower most part of the lower aquifer would be minimal and of no major consequence. It should be noted that the natural geohydraulical process of the dissolution of the saline minerals is occurring now and has been occurring for probably millions of years. The beneficial environmental effects of the existing anhydrite, as dry flue gas desulfurization agent, far out weight any minimal effects the mine process will have on the central Piceance Creek basin geohydraulogic system. 56, 60, 19

I will have to submit the written comments if that is okay by the September 23 deadline. Thank you.

WILLY FRANK: Thanks Jerry.

We had a few people have come in. Would anybody else like to comment on the environmental impact statement?

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Well, in that case, then I guess we will wrap things up. I do invite you to stay around and come up and introduce yourselves to us and let us know if you have any questions or concerns we could discuss informally after the meeting. We do have some people that are directly involved with the project that are here if you would like to ask any questions of them. Martin Jones is with Cliffs Engineering Inc. and he's a project engineer with the Wolf Ridge Corporation sodium project. Jerry Daub is consulting geologist for the firm.

So with that I would like to thank you all for coming and for expressing your comments and participating in the management of public lands and approval of this mine plan. Again written comments can be submitted through September 23 and tentative release date for the final environmental impact statement is March of 1987. Thank you.

(Proceedings adjourned)

2. PUBLIC COMMENTS ON THE DRAFT EIS AND RESPONSES TO COMMENTS

2.2 Responses to Public Comments

2.2.1 Introduction

The numbered responses below correspond to the bracketed numbers on the comment letters and public hearing transcript in Section 2.1.3. Responses are listed, by subject, in alphabetical order. Responses may consist of a text change, a clarification of the draft environmental impact statement (EIS), or an explanation of why a particular issue was or was not addressed.

2.2.2 Responses

Air Quality

Response No. 1. Meteorologic data from Rio Blanco Oil Shale Company's Tract C-a monitoring station on Sagebrush Hill (approximately 10 miles west of the proposed facilities) were used because of their completeness and proximity. Data from 1982 was selected because of its high recovery, availability of 60 meter winds, and site-specific sigma theta sensors (standard deviation of wind direction). The data is typical (nonanomalous) when compared to all data collected since 1975, and well suited for defining annual and worst-case conditions. The terrain at both locations is similar; both are located on top of benches (plateaus) in the Piceance Basin. Monitoring data were collected at 7,300 feet mean sea level; the proposed facilities are at 6,600 feet mean sea level.

Response No. 2. All activities associated with the sodium leases must comply with applicable federal, state, and local air quality regulations and implementation plans. The State of Colorado, Department of Health, has the responsibility and authority to enforce the Prevention of Significant Deterioration program (including determining Best Available Control Technology and tracking increment consumption). The appropriate federal land manager of the Prevention of Significant Deterioration Class I or state Category 1 areas is responsible for determining whether predicted impacts to air quality related values would be adverse. These determinations cannot be made until Wolf Ridge Corporation (WRC) presents very specific engineering plans to the State. Thus, additional analysis would be necessary before approval of the 500,000 Tons Per Year (TPY) Alternative.

Response No. 3. The U.S. Environmental Protection Agency (EPA), along with several other federal and state agencies, universities, industrial and environmental groups, are cooperatively studying the physical, chemical, biological, and legal aspects of atmospheric deposition. The Bureau of Land Management (BLM) is a formal participant of several research programs (including the National Acid Precipitation Assessment Program, National Atmospheric Deposition Program-National Trends Network, Western States Acid Deposition Program, EPA Regional VIII-Western Atmospheric Deposition Task Force, and Forest Service-Rocky Mountain Forest and Range Experiment Station Atmospheric Deposition Research Project) to assess state-of-the-art knowledge for incorporation into management decisions.

Alternatives

Response No. 4. The alternatives were developed to show a range of possible development scenarios in order to contrast potential impacts from WRC's proposal—the 125,000 TPY Alternative. The 500,000 TPY Alternative represents a maximum production rate project that could conceivably be viable based upon existing and projected future economic and market conditions. Market expansion, such as acid rain legislation requiring dry-sodium desulfurization controls, would make this a viable alternative.

Aquatic, Wetland, and Riparian Habitats

Response No. 5. BLM's identification criteria and concept of riparian/wetland habitats is consistent with definitions provided within Executive Order 11990, Protection of Wetlands (Federal Register Vol. 45, No. 25, page 7895, February 5, 1980) and is in principle identical with that used in FWS/OBS-79/31. Per your request, we have incorporated Cowardin's wetland classification system. Please note that the entire wetland section has been rewritten to reflect revised groundwater pumping rates, corrected hydrologic evaluations, and current wetland inventory data.

During recent reconnaissance of Yellow Creek, we found the estimated wetland acreage used in the draft EIS in error. Our former estimate was based on interpretation of 1979 color aerial photos—channel character and the extent of habitats supported by Yellow Creek have changed dramatically since that time, apparently in response to increased mean precipitation received in this watershed

during the growing seasons (i.e., Rio Blanco Oil Shale Company data, April through September 1978-1980 (6.04 inches), 1984-1986 (12.01 inches)).

In addition, flow depletion calculations were found to be in error, being predicated both on former pumping rates and hydrologic assumptions. These figures have been revised accordingly.

Response No. 6. We have tried to be more specific in this regard. Please see revised Section 4.9.6 in the TEXT CHANGES section of this document.

Response No. 7. We have made impact assessments more specific in this regard. See corrections or revisions pertinent to Sections 4.9.3, 4.9.4, and 4.9.6 in the TEXT CHANGES section of this document.

Due to the complexity of ground and surface water interactions, it would be extremely difficult to isolate a cause and effect relationship between surface water depletions and wetland maintenance without an inordinate amount of effort expended on long-term monitoring of surface flows, precipitation, alluvial saturation, and vegetation. Based on our hydrologic analyses, BLM believes there would be no functional alteration of Yellow Creek's wetland habitats under the No Action, 50,000 TPY Alternative, and the Proposed Action (see text revisions for Section 4.9.3 (page 4-19 of draft), Section 4.9.4 (page 4-20 of draft), and Section 4.9.6.1.1) and do not warrant mitigative stipulations. However, flow depletions associated with the 500,000 TPY Alternative do pose an obvious threat to the continued maintenance of Yellow Creek's wetlands (see revised text for Section 4.9.3 (page 4-19 of draft), Section 4.9.4 (page 4-20 of draft), and Section 4.9.6.1.2). We feel the most efficient way of dealing with these problems is the following:

> Prior to BLM's approval of the 500,000 TPY Alternative, BLM would require additional hydrologic evaluations to be performed by the applicant as the basis for revisions to wetland impact assessment. BLM would then attempt to develop an equitable means of determining wetland values foregone as a result of mining, and through stipulations attached to the mine plan, require the applicant to offset net losses of wetland values through project life and until mine-related impacts, which persist beyond mine life, reach negligible proportions.

Area of Critical Environmental Concern

Response No. 8. It is not within the realm of this document to explain the reasons for The Nature Conservancy's nomination or BLM's dropping of this nominated area of critical environmental concern (ACEC) from designation consideration. For your information, The Nature Conservancy nominated the Yellow Creek Basin area for ACEC designation because they felt it contained significant ecological values (a number of stands of *Artemesia tridentata spp. wyomingensis/Agropyron smithii* plant association and a large area of *Astragalus lutosus* habitat). Based upon BLM's interdisciplinary analysis, this area failed to meet the required identification criteria of relevance and importance for a potential ACEC. The plant association is relatively common throughout the White River Resource Area with extensive acreages throughout. At least eleven locations containing this plant association, in comparable condition, have been identified by BLM, varying in size from 40 to 1,200 acres with most averaging 160 acres. In addition, by definition of its current ranking, this association is demonstrably secure globally. *Astragalus lutosus* is much more common than initially thought; populations of this species are contained within five separate areas which have been designated as ACECs by BLM. For more detailed information, an information bulletin on the ACECs is available, upon request, from the BLM White River Resource Area office in Meeker, Colorado.

Baseline

Response No. 9. This sentence has been revised for clarification (TEXT CHANGES section). Also refer to the draft EIS, page 2-30, Section 2.5, Baseline. Projects considered for cumulative analysis consist of past, present, and reasonably foreseeable future projects occurring in the same general area, including, for example: Federal Oil Shale Lease Tracts C-a and C-b, and the Union Shale Oil Project.

Cultural/Paleontological Resources

Response No. 10. It is known that any earth disturbing or extensive collecting activity on any cultural or paleontological resource would definitely result in the destruction of that resource. No change.

Response No. 11. Final consultation with the Colorado State Historic Preservation Office was completed on February 9, 1987. Three known sites were identified for further work. Testing and/or mitigation measures for these sites was agreed on. In addition, stipulations regarding undiscovered resources were developed.

Farmlands of Statewide Importance

Response No. 12. The stream being referred to is Yellow Creek. The text has been changed on page 3-17, heading 3.5.1, paragraph 1, sentence 2 to clarify this.

Response No. 13. Your statement that "it is not likely that any significant impact would occur" is correct and is qualified in the draft EIS, page 4-14, first column, first paragraph, second sentence. Although the chance of a spill from the piping or evaporation ponds is unlikely, it is still possible. If, as an example, one or more of the evaporation

pond embankments failed, the salts in those ponds could be carried downstream to Yellow Creek. This could significantly affect vegetation production on farmlands of statewide importance along Yellow Creek.

Response No. 14. Water contamination refers to salt contaminated water as a result of a spill from the evaporation ponds, piping, etc. Yes, the aerial extent of the affected lands, in relative terms, would probably not be very large—100 acres or less.

Fluid Minerals

Response No. 15. No change. Please read the draft EIS, Section 4.3.1, Fluid Minerals, page 4-7. Although drilling through these formations is difficult because of the natural conditions of poor rock quality, the addition of cavities and rubble zones would further complicate drilling, but would not preclude oil and gas development. If the driller is aware of these potential problems, then they can be avoided.

Fly Ash

Response No. 16. BLM calls your attention to limited information supplied by Wolf Ridge Corporation, July 18, 1985. The ash will represent approximately 54 percent of the flue gas desulfurization/fly ash waste stream. The balance of the stream will be Na_2SO_4 with traces of $NaHCO_3$. A total break down of the mineral analysis of this ash is provided in Volume 5 of the Mine Plan for a Nahcolite Solution Mine submitted to BLM by Wolf Ridge Corporation. Specific leaching characteristics would be dependent upon slurry and formation make-up for underground disposal or the compaction and moisture content of the pile in surface disposal.

General

Response No. 17. No change. For consistency, this mitigation requirement corresponds to the stipulations of right-of-way grant, C-37773, which covers the off-lease segment of the road.

Response No. 18. This is a summary statement of 4.12 which states any commercial-scale development "would influence, but would not preclude" other development rights of the impacted federal lands. The surface acreage encumbered could be from 118 to 960 acres (draft EIS, page 2-33, Table 2-1).

Response No. 19. We agree that the use of nahcolite as a dry flue gas desulfurization agent and in neutralization of acid rain affected lakes would certainly benefit the environment. However, our impact analysis on the geohydrologic system in the Piceance Basin indicates a potential for more than "minimal effects". Your comment, although noted, is not supported by the impact analysis.

Response No. 20. A brief description of product uses is contained in Section 2.2.1 on page 2-1 of the draft EIS. This section has been expanded to include a brief discussion of alternative uses (e.g., flue gas desulfurization agent and neutralization agent for acid rain affected lakes).

Response No. 21. The Wheatcraft et al. 1985 report was utilized in the analysis of subsidence and the potential effects on groundwater flow, although the reference is not cited within the text.

Geology

Response No. 22. We agree. Please see the draft EIS, page 4-7, Section 4.2.2.5, Boundary Pillars.

Response No. 23. Please see the TEXT CHANGE section for page 3-6. The discussion on the rubber beds has been moved to the Geology section for clarity.

Groundwater Monitoring

Response No. 24. BLM believes that 6 months prior to mining operations and 3 years of continued monitoring, after mining operations are completed, will provide a more detailed analysis for protecting the groundwater resources in the Piceance Basin. The referenced stipulation is worded so that monitoring parameters and duration may be adjusted at the BLM authorized officer's discretion, based upon consideration of "in-hand" monitoring data, new information, or other circumstances. For further clarification on monitoring needs, please refer to the TEXT CHANGES section for pages 4-8 to 4-13 (Water Resources, Environmental Consequences).

Response No. 25. These components were agreed to at the December 13, 1985, meeting in Rifle, Colorado, at which WRC was present. The stipulation allows for the BLM authorized officer to change monitoring parameters based upon review of initial monitoring results. For additional clarification, please see Appendix C.

Response No. 26. BLM believes that 6 months of continuous monitoring prior to mining operations is the minimum necessary to obtain reliable premining baseline conditions needed to evaluate projected and actual impacts on lease.

Response No. 27. Your comment is noted. BLM will require that a detailed monitoring plan be submitted by the company prior to actual startup of production on site. This plan will detail monitoring zones, number and location of wells, constituents and levels, and frequency of samples to be taken from the groundwater regime in and around the production well field. In addition, BLM will require

that the company keep all brines or increased levels of saline minerals contained within the boundaries of the lease and that remedial action be taken if monitoring wells detect increases in dissolved solids migrating from the production well field. For further details and clarification of monitoring requirements, see monitoring summary in the TEXT CHANGES section (Water Resources, Environmental Consequences). In addition, please refer to Appendix C.

Response No. 28. Dedicated hydrologic monitoring wells are those wells located outside of the production well field and outside of the zone of influences of subsidence for the purpose of gathering baseline values both up and down gradient of the field. These may either be newly completed wells, existing in-place wells, or a combination of both. In addition, if monitoring in the well field indicates increased dissolved solid concentrations, the dedicated monitoring wells would be used to pick up or tract any potential plume migrating from the fields. Therefore, BLM feels that it is necessary to maintain a reliable monitoring system surrounding the well field.

Response No. 29. The "General Development Components" section in the draft describes the project only as proposed by WRC in their mine plan and only to the level of detail contained in the mine plan.

BLM is in complete agreement with EPA's proposal and will support same when the detailed monitoring plan is submitted.

Response No. 30. In addition to monitoring the lowest part of the lower aquifer, BLM believes that monitoring of the B-Groove is essential in detecting any leaks that may occur in well strings above the base of the lower aquifer. Monitoring of the B-Groove would also provide a backup system to the lower sampling interval and would aid in detecting any potential increase in dissolved solid movement and gradient flow changes from the dissolution surface upward into the lower aquifer.

Oil Shale

Response No. 31. The best interest of the United States Government is the conscientious preservation, development, and use of its resources, as appropriate. The multimineral resource should be developed in such a manner that the highest recovery of all resources will be attained. One resource should not be foregone for the other. The Boies Bed would not be recoverable by conventional mining methods and no impacts to the oil shale resources are predicted; therefore, the recovery of this nahcolite by solution mining is a plus in the overall recovery of minerals in the Piceance Basin.

Response No. 32. Modified In Situ (MIS) methods are not conducive to heavily fractured ground as exists in the sodium lease tract area. MIS retorts are subjected to high negative pressure. Leakage of air from one retort to another, or from mine air to the retort, can be very detrimental to the process as well as create safety hazards. MIS has not been sufficiently demonstrated in the basin to announce it as a viable mining method in the basin.

Response No. 33. As stated in the referenced paragraph, the poor rock quality has rendered the recovery of minerals from the R-6 Zone within the sodium lease area unfeasible by existing recovery methods, and the Mahogany Zone will not be affected by the proposed nahcolite recovery of the Boies Bed. Although the quantity figures for oil shale and sodium resources are not in a table format, they are in the narrative section you refer to.

Response No. 34. No change. The total thickness of the identified minable zone is as much as 60 feet, of which at least a 40-foot thickness would be extractable. The mining of this zone would, by definition, include the dewatering zone needed to mine this interval.

Oil Shale/Nahcolite

Response No. 35. Because of the proximity of the Boies Bed to the dissolution surface, that bed could not be recovered by methods other than solution mining. A lowering of the dissolution surface would take place over a very long period of time and would not render the underlying oil shale beds less minable. The distance from the dissolution surface down to the minable oil shale is sufficient so that necessary crown pillars can be left without loss of resource.

Oil Shale/Water Resources

Response No. 36. The premise of the environmental impact statement is the conservation of resources, both mineral and environmental. The solution mining of the nahcolite Boies Bed presents virtually no risk to the detriment of the future minability of the oil shale. The minable oil shale would remain virtually intact, as it is today, and any additional commingling of the aquifers, than exists today, would not be inherent. The monitoring and mitigation developed in this document will accomplish this goal.

Reclamation

Response No. 37. Considering the potential limitations on reclamation success (page 3-17 of the draft) and prescribed reclamation goals (page 4-15 of the draft), monitoring revegetation attempts over one growing season is not considered adequate. Since reclamation bond release criteria are predicated on relative production and crown cover of perennial species, including seeded shrubs, it is highly unlikely that the operator would be able to successfully satisfy the performance criteria within 1 year. A minimum

three season monitoring effort will help ensure reclamation success, providing a strongly established, self-sustaining vegetation community that meets stated postmine land goals.

Rock Quality/Mechanics

Response No. 38. Please see the TEXT CHANGES section for page 4-5 of the draft. A discussion on the area of collapse was added for clarity.

Response No. 39. Production of a cavity will be stopped when the calculated volume of the cavity has been produced. This will insure that the total pillar area will remain in place. Actual cavity configuration will be monitored using state-of-the-art methods as approved by the authorized officer.

The pillars have been designed based on accepted strength tests for the nahcolite material. Summarizing these tests is beyond the scope of this EIS.

Response No. 40. No change is necessary. The strata immediately overlying the cavities, including the lower leached zone, contains varying degrees of rock quality. Any caving and/or fracturing would significantly reduce the existing rock quality.

Response No. 41. No change is necessary. This section is an impact summarization and the sentence is correct as stated.

Rubber Beds

Response No. 42. BLM concurs with EPA on their concerns on the effectiveness of the rubber beds; therefore, subsurface subsidence of the solution cavity will be monitored during the pilot phase.

Stratigraphy

Response No. 43. No change. Figure 3-1A is a generalized, stratigraphic column and was used to give the reader a general idea of where the oil shale zones and aquifers are located. Inclusion of additional, site-specific profiles were not deemed necessary or appropriate for the purposes of this document. However, more detailed information is available for review at the White River Resource Area office.

Response No. 44. BLM does not refer to this entire section from the dissolution surface to the top of the R-8 as the leached zone. However, we do agree that leaching of sodium minerals has occurred in the upper Mahogany and R-8 zones, although not to the same degree as in the lower Mahogany down to the dissolution surface.

Subsidence

Response No. 45. Substantial subsidence has occurred because of the natural dissolution process within the basin. Any additional subsidence from WRC's proposal would only be incidental by comparison. Small additional movement to the identified minable zone in the Mahogany would not render it less minable than it exists today. If subsidence monitoring indicates significant impacts developing, then mitigation will be imposed on WRC to reduce these impacts (i.e., larger pillars between cavities, backfilling cavities, etc.) and bring the project into compliance with lease requirements.

Subsidence Monitoring

Response No. 46. Multiple point borehole extensometers are of different types and are available through several suppliers. Wires or rods are extended down the borehole in tubes or sheath. The down-hole end is anchored at the desired elevation, using a hydraulic or grout anchor to the borehole wall. The surface end is tensioned, and any movement in the hole at point of anchorage can be measured mechanically or electrically.

Multiple point borehole extensometers will be used to measure any deflections from the solution cavity up to the Mahogany Zone. It is the Mahogany Zone which is of concern and will be monitored. The upper Mahogany Zone is a semiconfining layer between the two aquifer systems and must be protected from excessive movement and fracture. WRC must submit a subsidence monitoring plan with location of surface monuments, subsidence monitoring drill holes, and their design and installation procedures for approval prior to mining operations.

Surface Disturbance

Response No. 47. Yes, we agree with your statement. That is why, as stated in the first sentence of the referenced paragraph, such impacts are not considered significant. No change necessary.

Response No. 48. BLM's goal in relationship to WRC's proposed well field development is to minimize surface disturbance and to facilitate successful reclamation of disturbed lands. Because of the lack of concise, detailed plans on specific well field mechanics and development, the analysis in the draft EIS considers and depicts the entire delineated well field as being potentially disturbed. However, based on the limited information in-hand, it appears that only 70 percent of the actual delineated well field area would be physically disturbed under any of the commercial-scale alternatives, assuming 300-foot spacing between well pairs. Assuming 600-foot well spacing, this figure is expected to drop to 40 percent.

2. RESPONSES TO PUBLIC COMMENTS

Text Change

Response No. 49. The text has been changed for clarification or to reflect your suggested change. Please refer to Section 3, TEXT CHANGES.

Vegetation

Response No. 50. The **natural** vegetation communities would be lost to surface disturbance for more than just a "temporary" period of time. To achieve predisturbance species composition and condition may require numerous years. For example, as explained in Section 4.6 of the draft, it could take up to 150 years for the pinyon-juniper plant community to achieve tree cover comparable to that before disturbance.

Response No. 51. As stated under the referenced section, "approximately 35 of the 45 acres within the remnant vegetation association (RVA) would be disturbed by the Proposed Action or 50,000 TPY Alternative. This represents 78 percent of the RVA and would essentially eliminate the value of this area for future studies and comparisons. This would be a significant impact to this specific population but would not be a significant impact to the general plant association because of its common occurrence in the area." The Proposed Action is the 125,000 TPY Alternative.

Waste Water Disposal

Response No. 52. No change necessary. The statement "unless otherwise approved in writing by the authorized officer", allows for alterations of approved operations on tract as necessary.

Response No. 53. No change. This mitigation allows the flexibility for disposal of drilling fluids by other methods if approved by the authorized officer. Evaporation may be a feasible alternative provided necessary time frames did not interfere with planned phase reclamation efforts.

Response No. 54. The "General Development Components" section in the draft EIS, as stated on page 2-1, describes the project only as proposed by WRC in their mine plan. It does not describe the action as BLM would approve it (i.e., with BLM mitigation applied). As stated under the "Committed Mitigation" section on page 2-25 of the draft, BLM will require that evaporation pond liner integrity be maintained during periodic removal of solids. If the liner is damaged during solids removal operations, the liner shall be repaired to the satisfaction of the BLM authorized officer. For further clarity, please see Appendix C.

Water Resources

Response No. 55. Your comment is noted. BLM recognizes and acknowledges the information and data submitted by WRC's consultants. BLM has not attempted to bias data or concepts in this EIS process, but has tried to present the most accurate and most accepted description of the hydrologic environment. BLM acknowledges hydraulic connections between the upper and lower aquifers; however, we do not agree with the one aquifer concept presented by WRC's consultants. That is why this EIS describes a two aquifer system in the Piceance Basin that is hydraulically connected and in communication to varying degrees, dependent upon strata and location.

Response No. 56. Your concerns have been clarified in the rewrite of the Water Resources section. Please refer to the TEXT CHANGES section for pages 4-8 through 4-13 (Water Resources, Environmental Consequences).

Response No. 57. WRC's representatives were made aware of the potential use of saline water for an alternative to fresh water supplies. However, because of technological and economic reasons, the saline water sources are not considered a viable water supply alternative for this project at this time.

Response No. 58. Yes, we agree in part with your statement. The use of groundwater for the pilot project, in and of itself, will not measurably deplete or alter the surface water system; however, the water usage from the project, when considered cumulatively, will contribute to adverse alteration of downstream endangered fish habitat as explained in Section 4.9.5 and in Appendix D of the draft EIS. Please reread these sections for clarification.

Response No. 59. The 20 percent figure was derived from the assumption that there is approximately 1,000 acres of saline minerals in contact with the lower aquifer along the truncation zone of the Boies and L-5E with the dissolution surface. Under the 125,000 TPY Alternative approximately 200 additional acres would be in contact with the saline minerals at the end of mine life.

Response No. 60. Your concerns have been clarified in the rewrite of the Water Resources section. Please refer to the TEXT CHANGES section for pages 3-8 through 3-14 (Water Resources, Affected Environment).

Response No. 61. (1) This section is describing the regional groundwater characteristics and is not site-specific; therefore, describing the Mahogany Zone to the site-specific project area is not appropriate within this section.

(2) By stating that the Mahogany Zone is a semiconfining layer, there is no need to add leaky; it is implied in the statement.

(3) Joints and dissolution features are examples of secondary porosity; therefore, no change is necessary.

Response No. 62. This data was submitted to BLM on May 1, 1984, from Cliffs Engineering, Inc. These data are from analytical results of water samples obtained during drilling of production well no. 1 and from the monitoring well at the bulk sample site.

Response No. 63. Comments noted. The paragraph you refer to was revised in the Water Resources rewrite to provide clarity, although it may be noted that if roof collapse did occur, brines would not immediately separate or stratify due to density differences for some period after structure stabilization.

Response No. 64. No change necessary. This action would cause a significant impact and would not just slightly change natural conditions.

Response No. 65. This sentence is describing travel time under natural conditions from the well field to the White River as estimated from Section 3.4.2 in the draft EIS, Groundwater, Site Specific, last paragraph (estimated flow of the lower aquifer is about 90 feet per year).

Response No. 66. No change necessary. The text is describing remedial actions taken, if and when, the monitoring systems detect movement from the well field or if dissolved solid levels increase.

Response No. 67. No change necessary. Comment does not add to the statement in the text. It is difficult to distinguish between a low probability and a very low probability when not using actual numbers or ranges.

Response No. 68. These figures have been revised due to a change in pumping rates and hydrologic assumptions. Current figures compare average maximum depletion values (e.g., 0.06 cfs for 125,000 TPY Alternative) with average monthly discharge records from the Yellow Creek U.S. Geological Survey (USGS) station for water years 1974 to 1982.

Response No. 69. Referral to a recharge rate of 20 and 50 years was incorrect and has been deleted from the text. The groundwater model, run by Wright Water Engineers, did not calculate the recovery rate for the aquifer or streams affected by the pumpage of water on tract. Therefore, estimated recharge rates and times were not obtainable.

Response No. 70. No change necessary. Changing "persist for the foreseeable future" to "the conditions would stabilize after a certain period of time", would not change the meaning of the text. Numeric values were not derived for this impact, therefore no change is necessary.

Response No. 71. Your comment pertains to information contained within the Biological Assessment prepared by BLM in fulfillment of Section 7 of the Endangered Species Act. This document appears in the draft EIS as reference material and is not subject to revision in the final EIS. However, BLM must inform the U.S. Fish and Wildlife Service (USFWS) Endangered Species Office of any deviations in project design or operation, or newly acquired information relevant to threatened or endangered species impact evaluation. Since BLM has refined the water resources analysis, USFWS will be informed of such changes through an amendment to the Biological Assessment.

Response No. 72. Based on USGS records for water years 1974 to 1982, Yellow Creek generally maintains flow throughout the year. To the best of our knowledge, the lower 10 miles of Yellow Creek has maintained continuous flow from October 1973 to present, except for consecutive days in September 1978 (6), December 1978 (17), January 1979 (14), and February 1979 (5).

Response No. 73. We acknowledge this correction and will notify the USFWS of this change.

Response No. 74. Projected flow depletions for "dry years" were based on USGS discharge records represented by the drought and recharge recovery years of 1977 and 1978 when abnormal low flow patterns were evident for Yellow Creek.

Response No. 75. BLM would like to expand in depth on head differences and the relationship of recharge and discharge areas in the EIS, but this document is not a technical report. Therefore, we present only a brief overview of consolidated data and findings.

Response No. 76. Injection pressures will only be sufficient to overcome the natural piezometric head and eject solution from the production well. For further clarification, please refer to the draft EIS, Sections 4.2.2, Rock Quality and 4.3, Mineral Resources; and the TEXT CHANGES section in this document (Water Resources rewrite) for proposed subsidence impacts from mining alternatives.

Response No. 77. The dissolution is not necessarily proportional to the areal extent, but for a general comparison it shows that the area affected is minute relative to the entire basin.

For clarity on the significance of groundwater impacts, please refer to the TEXT CHANGES section for pages 4-8 through 4-13 (Water Resources, Environmental Consequences).

Response No. 78. No change necessary. Wright Water Engineers contends that the upper and lower aquifers in the area of the production well field are in direct communication with one another, due to low head differences.

Well completion reports indicate that the upper and lower aquifer were properly isolated when this data was collected. However, the reported head differences alone do not substantiate increased communication between the aquifers.

2. RESPONSES TO PUBLIC COMMENTS

Response No. 79. BLM is in complete agreement for the need to develop a hydrologic model to evaluate salt loading, transport, and expected impacts from mining operations. However, BLM has used the best available information to determine possible impacts to the hydrologic system at this time.

Water Resources/Geology/Rock Mechanics

Response No. 80. The solution cavity will open slowly with the rate of dissolution of the nahcolite. The rate of caving will be proportional to the strength of ground, the size of opening, and the rate at which the opening is made. The loading to the strata overlying the solution cavity will take place slowly. As loading increases, sagging will occur in this strata, and some delamination of the strata immediately over the cavities would be expected. The thermal effect of the process waters on the structural integrity of the overlying strata to the solution cavities is within the limitation factors established for the caving of these beds. Over long periods of time, additional stresses may cause further caving. These stresses, on the character of beds, would cause caving at slow rates. With caving, turbulence within the immediate aquifer could be induced and porosity would increase, but the flow of the aquifer would not necessarily increase.

The rate of leaching due to cavity collapse is very difficult to predict and is dependent on the movement of water through the lower aquifer. With cavity collapse, dissolution would probably increase; however, the groundwater system will be monitored to see if there are any impacts.

Groundwater degradation and saline zone leaching rates were estimated from all available data and were presented in the EIS to give the reader an approximation of levels at which impacts were expected to occur. Other government agencies were consulted for comments and for interpretation of analysis for subsidence and leaching.

As stated on page 4-5 of the draft, Section 4.2.2.2, second column, first paragraph, rapid roof collapse is not expected. Therefore, rapid leaching is not expected either. However, extensive monitoring will be implemented to verify the predictions made in our analysis.

Only with development of the solution cavities in actual field conditions can all factors controlling ground stability be determined and verified. At the same time, monitoring of the aquifers will be required to detect and quantify impacts. If the impacts are significant, remedial actions will be taken.

The premise of the environmental impact statement is the conservation of resources, both mineral and environmental. The solution mining of the nahcolite within the Boies Bed presents virtually no risk to the future minability of the oil shale. The minable oil shale would remain virtually intact, as it is today, and any additional commingling of the aquifers, than exists today, would not be inherent. The monitoring and mitigation developed in this document will accomplish this goal.

Water Resources/Rock Mechanics

Response No. 81. The roof span and the pillar width could be altered to mitigate any unexpected caving of the cavity.

Response No. 82. Although plan views and cross sectional illustrations would be another piece of data, BLM believes that the text describes the cavities and groundwater flow patterns precisely and in sufficient detail for an EIS document. This is not a technical report.

Well Completion/Operation/Abandonment

Response No. 83. Please refer to Appendix B for BLM's technical evaluation of WRC's proposed well completion and abandonment procedures.

Response No. 84. Since maximum utility from the minimum allowable cement job is desired for this project, a comprehensive evaluation of the cement must occur. If necessary, remedial cementing procedures will be designed and executed to ensure adequate cavity isolation and a stable well bore environment for nahcolite extraction. The Cement Evaluation Tool log or equivalent will provide the data needed to fully evaluate the cement job. A Cement Bond Log, which does not provide the necessary data, is subject to well bore effects and is difficult to interpret.

The temperature log does not provide the accuracy necessary to determine the exact cement top or any information to determine cement bonding. Please refer to Appendix B for further clarification on cement bonding concerns.

Response No. 85. No change.

Occurrences of gas above the Saline Zone are documented. The potential for gas to accumulate within the voids left across the Mahogany Zone exists. There is also the possibility of water flow through voids across the Mahogany Zone that are opened during mining operations. Placement of a cement plug across the Mahogany Zone will maintain its function as a semiconfining layer to provide isolation of the upper and lower aquifer, and will also protect it for future recovery of the rich oil shale resource.

Response No. 86. This section explains WRC's proposed well completion program. Refer to Appendix C for the mitigating measures that will be applied to the approved action, regardless of the alternative.

There has been no concrete evidence submitted by WRC that will ensure or verify the existence of mud in the annulus during well life or after abandonment. This fact entered into our consideration and mitigation of the proposed well completion and abandonment. In addition, intensive monitoring during the pilot project and early stages of the commercial-scale project will help to determine the technical and environmental soundness of the chemical gel type mud (casing pack). For further clarity, please see Appendix A.

Response No. 87. This section does not describe the action as BLM would approve it. Please refer to the mitigation stated in Appendix C.

We acknowledge the fact that a fluctuating level of brine may exist in the 5 1/2-inch x 8 5/8-inch casing annulus; however, this brine is noncorrosive and a chance for a leak in the casing is remote. The leak detection system for production wells, as described in the draft EIS on page 2-8, Section 2.2.12.2, will detect any leaks greater than 3 gallons per minute (Jones 1985). Monitoring of sufficient groundwater bearing zones will detect leaks less than 3 gallons per minute. If any leaks are detected remedial actions will be required to prevent adverse impacts to groundwater.

Response No. 88. A portion of our committed mitigation (Appendix C) includes a requirement to run a Cement Evaluation Tool or equivalent log after cementing the 8 5/8-inch casing. This log is more comprehensive than a noise or temperature log in determining the cement bond and potential for fluid movement through channels adjacent to the well bore. Appropriate remedial actions will be taken to assure a competent cement bond, if needed.

Wildlife

Response No. 89. We concur with your statement that current vehicle related deer mortality has declined since the 1977-1981 period. This data was intended to illustrate that road kills can be a significant factor in deer mortality. However, we feel this information also supports general impact analysis and provides a basis for recommendations encouraging the use of employee mass transit and the scheduling of shift changes and product haulage to coincide with low activity periods of deer.

Response No. 90. Section 2.2.13, Other Applicant Proposed Mitigation on page 2-9 of the draft EIS, lists applicant-generated mitigative measures that are considered integral with the proposed action. Section 2.4.1.1.8, Range and Wildlife on page 2-29 of the draft, lists additional BLM-generated mitigation that would be imposed on the applicant. The first item under this section involves Raptor Research Report No. 4, although the address is apparently outdated. We have changed the address accordingly.

Response No. 91. BLM chose not to include the comprehensive species list traditionally comprised of known or expected wildlife occurrences. There are numerous government and consultant prepared compilations of this nature that are duly referenced in the text. As expressed in the draft EIS, in the opening paragraph of Section 3.8 (Wildlife), only those species that may be significantly affected or that befit special state or federal concern are discussed in detail. BLM would certainly consider incorporating additional species accounts if reasonable concern was expressed by the public or other involved parties.

Response No. 92. BLM believes that the deer-related mitigation scheme imposed through stipulation is commensurate with direct and indirect habitat losses associated with each alternative. Although we see short-term impacts as inevitable, we view wildlife-oriented site rehabilitation as fundamentally important in minimizing long-term impacts to the Piceance mule deer population. Concurrent habitat enhancement work is intended to ameliorate short-term effects, although we question the effectiveness of any mitigation strategy designed to fully compensate the immediate effects of habitat loss, especially considering the high degree of winter range fidelity demonstrated by Piceance deer and the difficulty in determining displacement patterns during project implementation. As stated on page 2-29 of the draft EIS, deer-related mitigation options are very much flexible at this point. USFWS involvement during mitigation coordination and development would be welcome.

Response No. 93. Raptor survey methods employed by WRC were outlined in their baseline report as referenced (Wolf Ridge Corporation 1984). Methods of data acquisition were reviewed and accepted by BLM before being used for impact analyses.

As additional information, pedestrian searches for active and inactive tree nests were conducted in a systematic fashion, along parallel zig-zag transects marked on USGS 7.5 minute topographic maps. Four man-days of intensive effort were expended in June 1984, covering 447 acres of pinyon-juniper habitat. Further information was gained opportunistically in the course of an additional 10 man-days of field work in July.

We believe this information is adequate to support current impact analyses and feel the information is at least as sufficient as the data bases available for other animal groups analyzed in this document. However, we also recognize the weaknesses inherent in one time/one season survey efforts, particularly when applied to long-lived projects. We have acknowledged the potential for future raptor nesting activity by imposing raptor nest survey requirements that include USFWS coordination (Section 2.4.1.1.8 in the draft).

3. TEXT CHANGES TO THE DRAFT EIS

3. TEXT CHANGES TO THE DRAFT EIS

This section consists of reprinted sentences, paragraphs, and other text changes to the draft EIS, including minor editorial corrections. Since the entire Summary (Section 1), Summary of Impacts (Table 2-2), and BLM Proposed Mitigation (Appendix C) sections from the draft EIS have been refined and reprinted in this volume, any changes in these sections are not listed. However, included in this section are complete rewrites for the Water Resources and Aquatic, Wetland, and Riparian Habitats (renamed Wetland Habitats) sections.

The changes are listed first by page number from the draft. Under the page numbers, the comment letter number(s) and/or transcript symbol that initiated the change are listed in parentheses. Changes to the text as a result of internal review have no number in parentheses.

Page 2-1

(13)

Column 2, paragraph 3, insert after sentence 3: "The sodium bicarbonate product also shows promise for use as a dry flue-gas desulfurization agent in coal-fired power plants and in neutralization of acid rain affected lakes in the eastern United States."

Page 2-8

(13)

Column 1, paragraph 7, sentence 2: ". . . on an annual basis . . . ." should read: ". . . on a quarterly basis . . . ."

Column 2, add at end of paragraph 1: "This monitoring system will detect any leaks greater than 3 gallons per minute (Jones 1985)."

Page 2-13

Column 2, paragraph 4, sentence 3: ". . . major and trace constituents, as . . . ." should read: ". . . major and minor components, as . . . ."

Column 2, paragraph 4, sentence 4: ". . . time trace elements shall . . . ." should read: ". . . time minor components shall . . . ."

Column 2, Trace Components listing: "Trace Components, (Sample initially and if lower aquifer is affected)" should read: "Minor Components, (Sample initially and if aquifer system is affected)"

Page 2-15

(11)

Column 2, paragraph 2, sentence 1: ". . . 019 x 0.07 . . . ." should read: ". . . 0.9 x 0.07 . . . ."

Page 2-16

(14)

Column 1, paragraph 2, sentence 1: ". . . *Suggested Practices for Raptor Protection on Powerlines—State of the Art in 1981*, Raptor Research Report No. 4, Raptor Research Foundation, Inc., c/o Dept. Veterinary Biology, University of Minnesota. St. Paul, Minnesota 55101." should read: ". . . *Suggested Practices for Raptor Protection on Powerlines—State of the Art in 1981*, Raptor Research Report No. 4, Raptor Research Foundation, c/o Carpenter St. Croix Nature Center, 12805 St. Croix Trail, Hastings, Minnesota 55033."

Page 2-33

(6)

Table 2-1, (Item) Water requirements gpm (ac-ft/year)/ no. of wells:
"60(88)/1 150(219)/1 80(117)/1 600(875)/2 [c]"
should read:
"60(93)/1 [d] 109(169)/1 [d] 80(124)/1 [d] 436(674)/2 [c d]"

[d] Assumes pumping at specified rate for 24 hours per day, 350 days per year.

3. TEXT CHANGES

Page 3-6

(11, A)

Column 1, paragraph 2, sentence 2: "From the lower Mahogany to . . . ." should read: "From the middle Mahogany to . . . ."

(11, A)

Column 1, paragraph 2, sentence 3: ". . . these secondary effects are less . . . ." should read: ". . . these secondary effects, though they exist, are less . . . ."

(11)

Column 1, paragraph 6, sentences 4 and 5: "Three thin . . . . elastic properties." should read: "Three thin (2-3 feet thick each) beds of low yield clay rich marly shale stone occur above the Boies Bed in the L-5 Zone. These beds are known as the "rubber beds" because of their plastic behavior when unconfined. Experience obtained during drilling indicates that these beds probably could seal small cracks in the rock by swelling into the crack. The beds appear to be continuous over the area of the well field."

(11, A)

Column 2, paragraph 2 (full), sentence 1: ". . . up to the lower Mahogany Zone . . . ." should read: ". . . up to the middle Mahogany Zone . . . ."

Page 3-8

(11)

Column 1, paragraph 1, sentence 4: "Although the leached zone below . . . ." should read: "Although the R-6 Zone below . . . ."

Page 3-8 through 3-14

(6 thru 14, A)

Section 3.4, Water Resources has been reprinted.

3.4 WATER RESOURCES

3.4.1 Surface Water

3.4.1.1 Surface Water Quantity

The sodium leases lie within the Piceance hydrologic basin. Piceance and Yellow creeks, which both drain into the White River, are the principal drainages within this basin.

Surface runoff in the Piceance Basin is from snowmelt during spring months and high-intensity summer thunderstorms. Most annual flow from Piceance and Yellow creeks is sustained by groundwater discharge. The groundwater discharge to surface flows has been estimated to be 80 percent of the total flow of these creeks (Weeks et al. 1974).

Recharge to the groundwater system is principally from snowmelt. Snow accumulates during the winter months at elevations in excess of 7,000 feet. Snowmelt produces a period of high streamflow during the spring (Weeks et al. 1974). Table 3-1 summarizes the principal characteristics of the two streams.

Different periods of record are available for the two streams; therefore, the numbers presented in Table 3-1 are not directly comparable. The flow from Yellow Creek is more erratic than the flow from Piceance Creek, and the majority of the surface flow leaving the Piceance Basin comes from Piceance Creek.

The drainage system within the sodium lease area is characterized by a series of intermittent and ephemeral streams; rolling uplands; steep valley sideslopes; and short, narrow, relatively flat valley bottoms near Yellow Creek. Steep slopes, coupled with intense storms, have resulted in localized mass-wasting of land forms along the upper and middle channel reaches, leading to the accumulation of alluvial fill and the creation of alluvial fans at the confluence of drainages within Yellow Creek. In many sections, the channel bottom is on sandstone and shale bedrock. The channel gradient of the tributary drainages throughout the lease area averages 2.5 percent.

The sodium lease tract area drains into two streams, Yellow Creek and Piceance Creek (Map 3-2). The majority of the area (96.5 percent) is drained by the Yellow Creek watershed, and the remainder (3.5 percent) is drained by the upper portion of Horse Draw, a tributary to Piceance

TABLE 3-1

CHARACTERISTICS OF PICEANCE AND YELLOW CREEKS

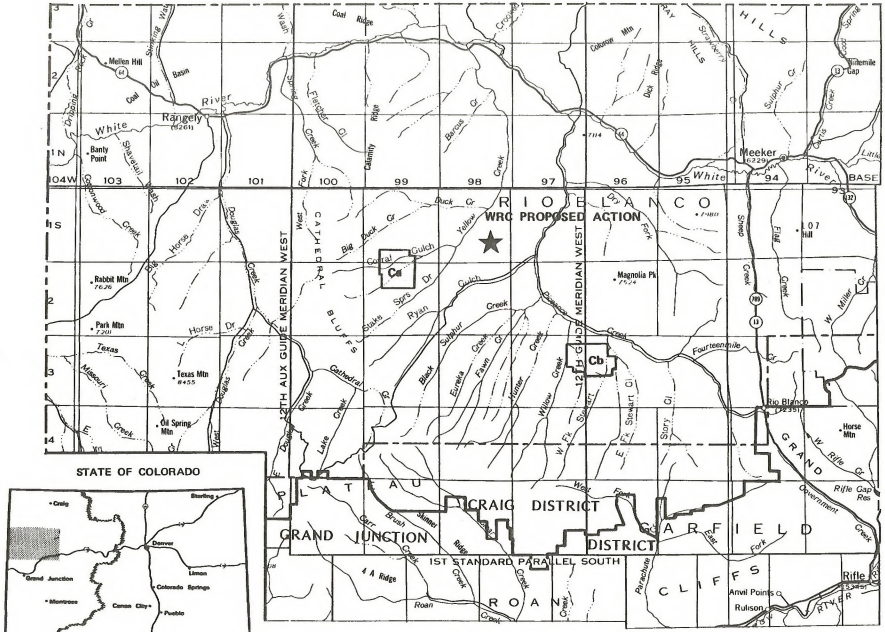
Characteristics	Piceance Creek At White River	Yellow Creek
Drainage area (square miles)	652.00	262.00
Average annual discharge (acre-ft)	24,270.00 [c]	1,340.00 [a]
Maximum daily discharge (cfs)	525.00 [c]	500.00 [a]
Minimum daily discharge (cfs)	0.50 [c]	0.00 [a]
Average daily discharge (cfs)	33.50 [c]	1.85 [a]
Maximum instantaneous discharge (cfs)	628.00 [c]	6,800.00 [a]
Sediment discharge (tons)	56,115.00 [b]	12,495.00 [b]
Maximum daily sediment discharge (tons/day)	6,090.00 [c]	290,000.00 [a]
Minimum daily sediment discharge (tons/day)	0.10 [c]	0.00 [a]
Maximum TDS (mg/l)	1,200.00 [d]	2,090.00 [b]
Minimum TDS (mg/l)	670.00 [d]	489.00 [b]

[a] For the period 1972-1980.
[b] 1980 water year.
[c] October 1970 to September 1984.
[d] 1984 water year.

Source: USGS Water Resource Data
Conversion: cfs × 1.9835 = acre-feet per day.

Creek. Horse Draw is very steep, small in size, and in the extreme southeastern portion of the lease tract. Surface runoff to this drainage basin is not expected to be affected by lease operations.

Total drainage area to Yellow Creek within the lease area is 13.1 square miles, or about 5 percent of the 262 square mile basin area of Yellow Creek. Three unnamed ephemeral tributaries to Yellow Creek drain the proposed mine site. Flow in Yellow Creek is intermittent in much of its middle reach and perennial in some upstream reaches and in the lowest several miles of the stream. Flow is dependent on annual precipitation, snowpack depths, thickness of the alluvium, and for several years until 1982, on mine water discharge from Oil Shale Tract C-a. Average daily discharge from Yellow Creek near the confluence with the White River is 1.85 cubic feet per second (cfs), or about 1,340 acre-feet per year. The gauge at the mouth of Yellow Creek was discontinued in 1982. Only 10 years of discharge records are available. Extremes for the period of record include several no-flow days and a maximum discharge of 6,800 cfs on September 7, 1978. This was a flash flood that carried a sediment load of 290,000 tons. The high flow followed an unusually intense thunderstorm, most of which fell only in the downstream one-third of the Yellow Creek drainage. The suspended sediment load in Yellow Creek at White River for 1980 was about 12,000 tons per year. The 13.1 square mile drainage area within the leases could generate a 100-year peak-flow of 80 cfs (Kircher, Choquette and Richter 1985). This would be the 100-year storm contribution from the drainage areas within the leases to Yellow Creek.



LOCATION OF SURFACE WATER-DRAINAGES

MAP 3-2

No springs occur in the lease area or within 1/2 mile of the lease boundaries. The closest springs to the lease area are located in Yellow Creek and Corral Gulch.

3.4.1.2 Surface Water Quality

There are no site-specific water quality data for the ephemeral tributary drainages on the lease tract area. Sparse data in similar areas suggest that runoff probably contains a few hundred milligrams per liter (mg/l) total dissolved solids (TDS). A recent report by Tobin et al. (1985) and water quality analyses published by the U.S. Geological Survey indicate that the surface waters of Yellow Creek and its tributaries can be classified as a mixed bicarbonate type in the upper reaches, grading to a sodium bicarbonate type in the lower reaches. This change in water quality is thought to be caused by groundwater discharge from the Uinta and Green River formations (Weeks et al. 1974).

Water temperatures in Yellow Creek range from summer highs in the 86°F to 95°F range, to 32°F during the winter months. Specific conductance, which is related to TDS content, typically is in the range of 800-1,500 uhmos (550-1,000 mg/l TDS) in the upper reaches, and 3,000-4,000 uhmos (2,000-2,500 mg/l TDS) at the mouth of the creek. Dissolved solid concentrations typically decrease during the spring high-flow period because of dilution from snowmelt runoff. During low-flow periods, the concentrations increase because of irrigation return flow and groundwater discharge. Piceance Creek has similar water quality; it also shows an increase in TDS in a downstream direction, however, TDS levels are generally less in Piceance Creek than in Yellow Creek (Weeks et al. 1974).

3.4.2 Groundwater

3.4.2.1 Regional Setting

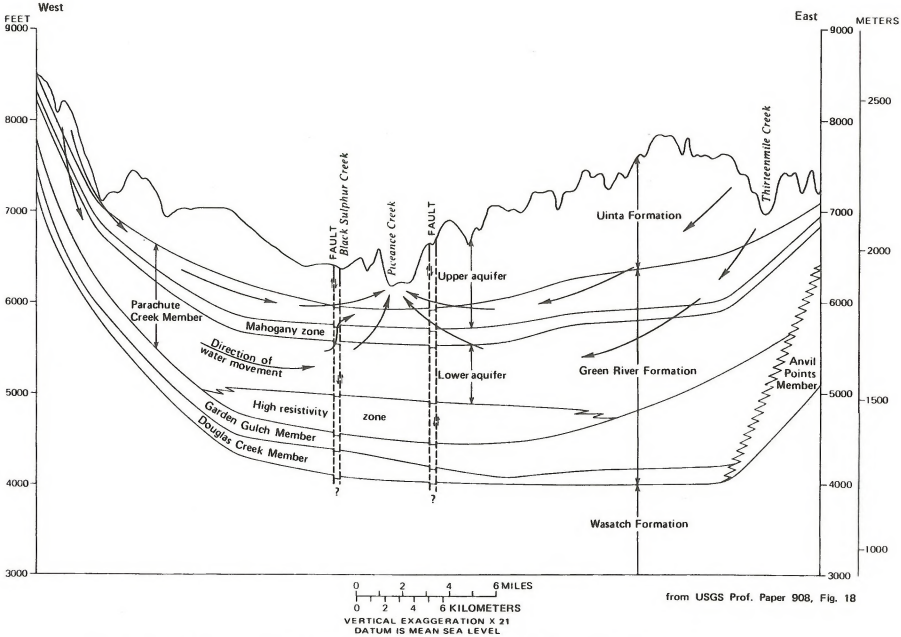
The principal usable bedrock aquifers that occur in the basin are commonly referred to as the upper and lower aquifer systems of the Uinta and Green River formations. Figure 3-2 shows a generalized geohydrologic cross section of the Piceance Basin aquifer system. These aquifers are recharged at the higher elevations on the west, south, and eastern margins of the basin, by lateral inflow and deep percolation to the upper aquifer through the Uinta Formation. Flow is generally to the north-central part of the basin (Weeks et al. 1974). The aquifers discharge to Piceance Creek and Yellow Creek which discharge into the White River. The Piceance Basin groundwater system probably does not discharge directly to the White River, because the White River flows on alluvium which rests on the Wasatch Formation, which is hydrologically isolated from the Green River Formation within the basin. For this analysis, it is assumed that the groundwater transport of salt/dissolved solids is a closed system in the Piceance Basin, with all inputs restricted to the basin and out flow by way of discharge to Piceance and Yellow creeks.

Three major aquifer systems occur within the basin: the alluvial, upper, and lower aquifers. These aquifers have limited hydraulic connection with one another, and are considered separate reservoirs. The degree and extent of hydraulic connections are not yet fully understood and probably vary considerably by location within the basin.

The major alluvial aquifers are restricted to stream valleys and do not occur on uplands. Most of the stream valleys in the basin contain recent alluvial material, ranging in thickness up to 140 feet, are less than one-half mile in width, and are saturated in certain areas. This saturated zone is the alluvial aquifer, which is generally unconfined and varies greatly in size and yield from one stream valley to another. The alluvial aquifer system is important, in that it functions throughout most of the basin as a transient storage system to move groundwater to or from streams and the deeper aquifers.

The upper and lower aquifers are bedrock aquifers, within the Uinta Formation and the Parachute Creek Member of the Green River Formation (Figure 3-1A). The upper aquifer contains confined and unconfined water bearing zones and extends from the top of the Mahogany Zone to the surface. The upper portion of the Uinta Formation contains discontinuous, unconfined water bearing zones (perched aquifer) throughout the basin. These beds occur in the ridges between stream valleys and usually can be identified by the occurrence of springs above the valley bottoms. Perched aquifers are sometimes associated with alluvial aquifers, where streambeds intersect permeable outcrop areas. The upper confined bedrock aquifer extends from the top of the Mahogany Zone to the base of the unconfined Uinta. The principal water bearing zone in the aquifer is the A-Groove located just above the Mahogany Zone. The remainder of the upper aquifer consists of confined water bearing zones that vary with depth and permeability.

The lower aquifer extends from the dissolution surface up to the base of the Mahogany Zone. The principal water bearing zone is the B-Groove, and the remainder of the aquifer yields varying quantities of water depending on the depth and the degree of secondary porosity developed. Secondary porosity is created principally by fracturing and as a result of dissolution of the soluble salt nodules and layers within the oil shale. The secondary porosity developed in the dissolution features could result in high rates of water movement throughout the zone; however, the irregularity and localized occurrence of the dissolution features also accounts for some wide variations in porosity and permeability.



Generalized geohydrologic section through the Piceance basin showing relation of the aquifers to the Green River and Uinta Formations. The arrows show diagrammatically the direction of ground water flow. WRC lease area is approximately 5 miles north of this cross section.

FIGURE 3-2

The base of the lower aquifer is directly overlying the saline mineral and oil shale intervals, which make up the saline or high resistivity zone of the Parachute Creek Member of the Green River Formation. The contact between the lower aquifer and the Saline Zone is called the dissolution surface. Dissolution of the saline minerals by the lower aquifer is an active natural geologic process. The rate and extent of this process is not completely known and may be quite variable, depending on permeability throughout the basin. Basin wide, there may be as many as 20,000 acres of dissolution surface which are in direct contact with saline minerals.

The upper and lower aquifers are separated by the Mahogany Zone of the Parachute Creek Member of the Green River Formation (Figure 3-1A). Regionally, the Mahogany Zone is considered a semiconfining layer between the two aquifers, which allows some communication between the two aquifers through secondary porosity developed in fractures in the Mahogany Zone. Because of its high kerogen content, the rock is less brittle; therefore, the Mahogany Zone is less susceptible to fracturing than the strata containing the upper or lower aquifers. In some places in the basin the Mahogany Zone is not fractured and allows very little communication between the aquifers. In other areas substantial communication takes place (Weeks et al. 1974; Robson and Saulnier 1981; Daub, Weston and Rosar 1985; Wright Water Engineers and Daub & Associates 1985; Weston 1984; Industrial Resources, Inc. 1984).

The two bedrock aquifers are generally confined or artesian. This means that the hydraulic head (water level) of a well in the water bearing zones will be higher than the top of the aquifer. The relative degree of communication between the aquifer systems can be inferred by the difference in the hydraulic head of the two aquifers. If there is a great deal of communication between the two aquifers, one would expect little difference in the hydraulic head between the aquifers. There are few places in the basin where the head difference exceeds 200 feet; generally, the difference in head does not exceed 100 feet (Weeks et al. 1974).

The aquifer systems are estimated to contain between 6.5 and 22 million acre-feet of water in storage at any one time (Robson and Saulnier 1981). The saturated thickness of the upper and lower aquifers ranges from 1,300 to 1,500 feet. The aquifers discharge approximately 18,000 acre-feet per year to the surface water, directly through springs or indirectly through discharge to the alluvial aquifer.

3.4.2.2 Site Specific

Hydrogeologic characteristics in the sodium lease area vary slightly from the regional description based upon limited site-specific data. Alluvial aquifer material occurs on lease in small sections of Stake Springs Draw and Yellow Creek. Collectively, the areal extent of these areas is approximately 80 acres. A perched aquifer does exist in the lease area and is approximately 400 feet below the surface. Water yield within this zone is estimated to be about 10 gallons per minute.

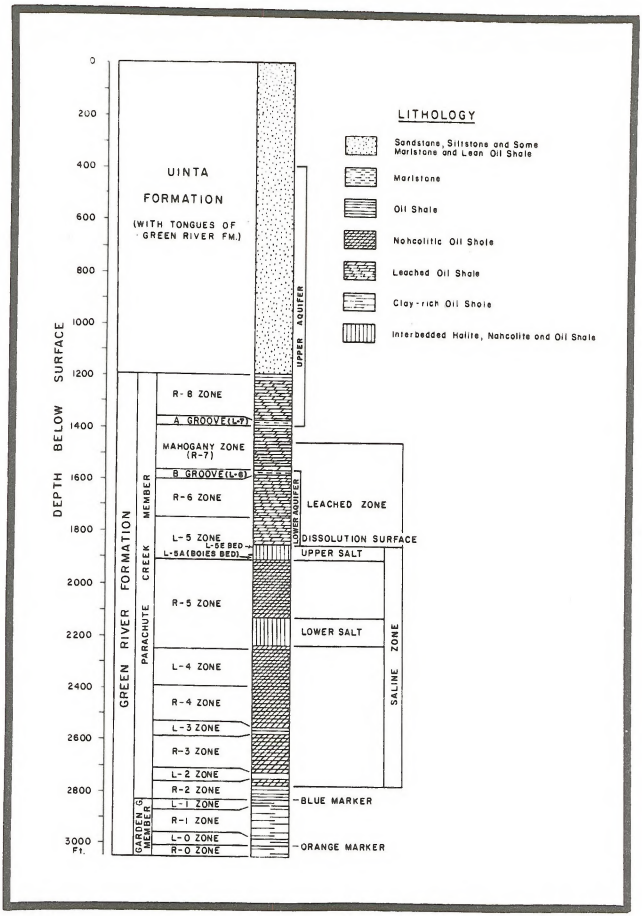
The hydraulic head difference between the upper and lower aquifers ranges from zero to tens of feet within the sodium leases. The difference in hydraulic head at the proposed well field is less than 10 feet. Limited data indicates more communication between the upper and lower aquifers within the sodium leases than regionally with the hydraulic gradient thought to be in the downward direction. Approximately the lower half of the Mahogany Zone within the lease area has dissolution features that now contain and yield water. At least 1,000 acres of the dissolution surface within the sodium leases is in contact with saline minerals. This is a minimum amount because it only represents the acreage of the truncation zone of the Boies Bed; it does not measure the contact of the saline minerals of the L-5E Bed with the dissolution surface.

The aquifer pump tests conducted by the Multi Mineral Corporation and the USGS in 1981 in the eastern portion of the leases indicate that the direction of greatest permeability of the upper aquifer is to the northeast and the lower aquifer is to the northwest (Weston 1984). The hydraulic gradient in the aquifers is down dip to the north. Very little data are available that clearly describe the rate of flow of the aquifer system within the sodium leases. Preliminary indications, based upon the pump test, are that the upper aquifer flows at least 150 feet per year and that the lower aquifer flows at about 90 feet or more per year.

3.4.3 Groundwater Quality

3.4.3.1 Regional

Groundwater quality in the Piceance Basin varies widely both between and within the aquifers and by geographic location. The alluvial aquifer is classified as a sodium bicarbonate type, with concentrations of dissolved solids ranging from 470 mg/l to a high of 6,720 mg/l. Average levels of dissolved solids in the alluvium are nearer to 1,750 mg/l over the entire basin (Weeks and Welder 1974). Higher TDS levels occur downstream toward the White River; they are attributed mainly to irrigation water returns, groundwater inflow from bedrock aquifers, and the concentrating effect of evapotranspiration (Weeks et al. 1974).



General Stratigraphic Column of Uinta Formation and Upper Green River Formation
FIGURE 3-1A

Water quality of the perched aquifer is classified as a calcium-magnesium bicarbonate type with TDS ranging from 200 to 400 mg/l at the higher elevations of the basin. At lower elevations in the basin, water quality shifts to a sodium-sulfate bicarbonate with TDS ranging from 400 to 900 mg/l.

Groundwater in the upper aquifer system is classified as a sodium bicarbonate type with sulfate decreasing as a major anion in deeper water zones. Generally, concentrations of dissolved solids increase with aquifer depth and in a northerly direction. TDS concentrations range from 400 to 2,000 mg/l. This increase may be related to the natural dissolution of minerals and to groundwater movement from the lower to the upper aquifer (Weeks et al. 1974). Calcium, magnesium, and sulfate concentrations are generally greater in the upper aquifer than in the lower aquifer. Sodium, bicarbonate, and fluoride are higher in the lower aquifer.

The lower aquifer water is generally classified as a sodium bicarbonate type. Total dissolved solid concentrations of the lower aquifer vary from about 500 mg/l to nearly 40,000 mg/l and are dependent on depth and location. Dissolved solid concentrations of 63,000 mg/l have been reported (Weeks et al. 1974); however, this is not characteristic of lower aquifer water quality and is believed to have been caused by drilling operations near the dissolution surface. Limited data indicate that the quality of lower aquifer water deteriorates as it approaches the dissolution surface (Welder and Saulnier 1978).

3.4.3.2 Site Specific

Limited data of groundwater sampled on and near the sodium lease tracts indicates that the upper aquifer water tends to be a sodium-sulfate-bicarbonate type and typically contains 500-600 mg/l TDS, although some samples indicated levels as high as 1,000 mg/l. This data is a composite of all water bearing zones in the upper aquifer, and doesn't distinguish between the perched aquifer and remaining upper aquifer. Compared to the lower aquifer, it contains lower concentrations of TDS, fluoride, and chloride, and higher concentrations of calcium, magnesium, and sulfate. Water quality in the upper aquifer fluctuates from meeting the Colorado groundwater quality standards for drinking water as contained in "The Basic Standards for Groundwater" (Colorado Water Quality Control Commission 1987) to exceeding those standards in fluoride and pH, and marginally meeting the standards in iron. These variances occur by location on lease and by water bearing zones of the upper aquifer. Agricultural standards are also exceeded because of high levels of fluoride and pH.

Dissolved solid concentrations in the lower aquifer range from 650 to 9,610 mg/l (USGS, MMC 1981; WRC 1983-1984) with most samples falling in the 1,000 to 2,000 mg/l range. The lower aquifer does not meet the state standards for drinking water because of high concentrations of fluoride and marginal pH. The lower aquifer does not meet the state standards for agriculture because of excessive fluoride and marginal pH.

Table 3-2 shows some selected water quality parameters for the lease area and the state standards. This table is based

TABLE 3-2
WATER QUALITY PARAMETERS
FOR THE SODIUM LEASE AREA AND STATE STANDARDS

Parameter	Upper Aquifer [a]	Lower Aquifer [a]	Colorado Human Health Standards	Colorado Agricultural Standards
pH (units)	8.6 to 8.7	8.50	6.5-8.5	6.5-8.5
Fluoride (mg/l)	1.4 to 20.5	23.50	4.0	2.0
Iron (mg/l)	0.26	0.12	0.3	5.0
			All Waters	
			Background	Limit
TDS (mg/l)	855	2,210	0-500	400 mg/l or 1.25 times the background level, whichever is least restrictive.
			501-10,000	1.25 times the background value.
			10,001 or greater	No limit

[a] Samples collected in August 1984 from well IRI-PW-2 (Industrial Resources, Inc. 1984). Upper aquifer was also sampled in 1981 at the site of the MMC/USGS pump test about 1 mile from the proposed well field (Weston 1984).

on sparse water quality data from only a few wells and is not inclusive of all samples taken from the area. Samples have only been taken for a very short period of time; therefore, it is not possible to show how groundwater quality on the leases might naturally fluctuate over time.

3.4.4 Water Uses and Water Rights

Presently, the major water use in the Piceance Basin is irrigation. About 4,400 acres are irrigated annually, diverting about 33,790 acre-feet per year in the Piceance Basin (Kuiper et al. 1978). This number exceeds annual stream flow because of the large amount of return flow from irrigation usage. Livestock, wildlife, and limited domestic uses are the only other water uses in the basin. Within a 5-mile radius of the proposed well field are 22 vested water right holdings, 14 in Yellow Creek and its associated tributaries and 8 in Piceance Creek drainages. These are made up of 10 alluvial wells for domestic and livestock usage, one reservoir storage right, four springs, and seven ditch diversions for irrigation purposes. In addition, one well, which is completed in the lower aquifer, has been filed on for livestock watering use. A final decree for appropriated rights from this well has not yet been issued by the State of Colorado.

Other water rights held by the existing water users are a significant number of industrial water rights obtained by various parties because of the projected need for large amounts of water for the development of oil shale. Industrial Resources, Inc., holds several water right allocations on and off the leases in the form of groundwater, storage, and flow rights. All of these rights are associated with the development of Wolf Ridge Corporation's leases.

BLM recommends that the groundwaters within the sodium lease boundaries and those waters encompassed by the cone of depression caused from pumping of the water supply wells be classified as "Agricultural Use-Quality" in accordance with "The Basic Standards for Groundwater" (Colorado Water Quality Control Commission 1987).

3.4.5 Alluvial Valley Floors and Floodplains

Although the exact extent of alluvial valley floors within the sodium leases has not been determined, approximately 80 acres collectively in Yellow Creek and Stake Springs Draw may meet the definition of an alluvial valley floor.

Floodplains within the lease area occur along portions of Stake Springs Draw, Corral Gulch, Yellow Creek, and on a small unnamed tributary that flows into Yellow Creek. The potential for flash flooding exists throughout the area, resulting from snowmelt and high intensity localized thunderstorms. The mine site and support facilities are located on ridgetops and will not be inundated by potential floods, nor will mine operations impact these floodplains.

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(11)

Column 1, paragraph 7, sentence 2: ". . . project area, which are . . . ." should read: ". . . project area along Yellow Creek, which are . . . ."

Page 3-22

(14)

Column 1, paragraph 3, sentence 3: ". . . nests is located . . . ." should read: ". . . nests are located . . . ."

(14)

Column 1, paragraph 8, sentence 1: "... perennial aquatic habitats . . . ." should read: ". . . perennial wetland habitats . . . ."

(14)

Column 1, paragraph 8, sentence 2: ". . . sustain a very limited . . . April to May." should read: ". . . sustain a limited . . . April to May. Small number of waterfowl may remain on these creeks during the winter months, but ice buildup usually precludes use beyond mid-January."

(14)

Column 1, paragraph 8, sentence 3: "Aquatic habitat suitable . . . ." should read: "Habitat suitable . . . ."

(14)

Column 2, paragraph 1, sentence 1: ". . . and sagebrush ranges throughout . . . ." should read: ". . . and sagebrush ranges, and riparian-wetland associations throughout . . . ."

Page 3-23

(14)

Column 1, Section 3.8.6: Replace entire section.

3.8.6 Wetland Habitats

No wetlands exist on the project site itself; however, wetlands are found on those portions of Yellow and Piceance creeks (Map 3-2) potentially affected by groundwater pumping. Since groundwater analysis has demonstrated that the relative effect of groundwater pumping on Piceance Creek would be negligible (Section 4.4.1, Surface Water Quantity), wetlands associated with Piceance Creek have been dropped from further discussion.

The potentially affected portion of Yellow Creek (lower 12.9 miles) currently supports an estimated 126.5 acres of palustrine wetland comprised of four general classes (Cowardin et al. 1979). These statistics, gathered in late 1986, are probably not representative of average conditions. Late summer rainfall recorded for upper Yellow Creek (Rio Blanco Oil Shale Company data) during 1984-1986, was nearly triple (2.7x) that received during the same period (July-September) in 1978-1980, and 25 percent higher than 1981-1983. The vast majority of in-channel wetlands are confined to a deeply incised (15 to 35-foot deep) gully and are subject to the influences of actively eroding vertical cutbanks, alkaline soil and water conditions, highly variable annual and seasonal flows, and extensive scouring effected by ice action and periodic flooding. Wetland classification and acreage breakdown are provided in Table 3-4A.

Persistent emergent wetlands appear as a herbaceous zone occupying an average 10.6-foot wide fringe on either side of the streambed or oxbow beds. This zone is composed of two normally distinct vegetation groups. Obligate species (plants usually found only in wet areas) form dense growth immediately adjacent to the streambed, and are represented by sedges, meadow foxtail, inland saltgrass, and bulrush. A second group of primarily facultative species (plants found in both upland and wetland sites) normally form a band above the obligate zone, consisting of saltgrass, wheatgrass, basin wildrye, and foxtail. Shrub-scrub wetlands typically form the transition between herbaceous wetland and upland vegetation. Dominants include black greasewood, rubber rabbitbrush, big sagebrush, and tamarisk. This type is often poorly differentiated from adjacent uplands, being recognizable as a wetland type only by understory composition. Tamarisk appears sparingly throughout the Yellow Creek channel, but forms a dominant overstory in a consolidated 1 1/4-mile stretch below Barcus Creek.

Yellow Creek's streambed, averaging 7 to 8 feet in width, is predominantly a shale gravel substrate with mud or sand inclusions. The unconsolidated shore class represents channel braids, scour banks, and bars, which are usually gravelly and sparsely vegetated with annual forbs.

Off channel wetlands are limited to a 42.8-acre meadow on the alluvial terrace which historically was irrigated hayland. This area is composed of subirrigated facultative herbaceous and shrub species, and a small (5.8-acre) swale which supports sedge and foxtail growth.

Aquatic flora is sparse. Semiaquatic *Ranunculus* (buttercups) and algae occasionally occupy an extremely narrow interface between the wetted perimeter and shore. A single species of pondweed occurs in small, sparsely distributed colonies on submerged cobble or rocks. Small buoyant mats of brookgrass and watercress are found occasionally where in-channel springs or seeps emerge.

Yellow Creek has never supported a fisheries. Aquatic fauna consists almost exclusively of Diptera larvae (flies in the Chironomid and Simulid families) and Oligiochaetes (annelid worms). These macroinvertebrate populations are characteristic of alkaline environments subject to frequent perturbation. Investigators have attributed low diversity values to unstable substrates, the erosional nature of the drainage, and high salt content; variable, but often rich productivity figures (up to 7,000 Diptera larvae per square meter) to the species adaptive response to rapidly fluctuating environmental conditions (Pennak 1974, Cathedral Bluffs Shale Oil Company 1980).

A newly constructed beaver dam (1986), 2 miles upstream from the White River, is the only visual evidence of beaver activity in Yellow Creek. Constructed of tamarisk, the dam is currently nonfunctional and may be abandoned—stream flow having skirted the structure laterally into a vertical mud bank. This beaver's appearance is almost certainly related to increased flows in Yellow Creek generated by high precipitation over the past 3 years. We feel functional beaver activity is severely constrained in this drainage due to lack of suitable building materials and nutritious forage, the erosive properties of the channel, extreme flow fluctuations inherent to the system, and perhaps the chemical properties of the water itself (e.g., mucous membrane or dermal irritant).

Page 3-24

(15)

See reprinted Table 3-5.

3. TEXT CHANGES

TABLE 3-4A
WETLAND CLASSIFICATION ON AFFECTED PORTIONS OF YELLOW CREEK
(After Cowardin et al. 1979)

System: **Palustrine**	Estimated In-Channel Acreage by Land Status			Estimated Out-of-channel Acreage by Land Status			Total Acreage
	BLM	CDOW	Private	BLM	CDOW	Private	
CLASS: UNCONSOLIDATED BOTTOM							
Subclass: shale gravel, mud Dominance: Diptera larvae (Chironomidae, Simuliidae), Oligochaetes Modifiers: water regime - permanently/semiperm. flooded water chemistry - Oligosaline (x = 3,650 micromhos/cm) pH - alkaline (7.6-9.0) soil - mineral	18.6	6.1	0.5	—	—	—	25.2
CLASS: UNCONSOLIDATED SHORE							
Subclass: shale gravel, mud Dominance: pioneering annual forbs Modifiers: water regime-seasonally flooded							
CLASS: EMERGENT WETLAND [1]	(Unconsolidated shore lumped with unconsolidated bottom)						
Subclass: persistent Dominance: Carex spp., meadow foxtail, bulrush, saltgrass, wheatgrass, basin wildrye Modifiers:water regime- temporarily flooded (in-channel)	18.9	13.7	1.3				33.9
intermittently flooded (alluvial terrace)				—	4.3	—	4.3
seasonally flooded (alluvial terrace)				—	7.3	—	7.3
CLASS: SCRUB-SHRUB WETLAND [2]							
Subclass: broad-leaved deciduous Dominance: greasewood, rubber rabbitbrush, big sagebrush, tamarisk Modifiers: water regime- intermittently flooded	16.9	7.8	0.9	5.8	25.4	—	56.8
						Total "Vegetated" Wetlands:	101.3
						Total Shore and Channel:	25.2

1 Emergent wetland acreage composed (each bank on average) of a 5.1-foot zone dominated by saltgrass, wheatgrass and wildrye; subtended by a 5.5-foot wide zone dominated by two sedge species, meadow foxtail, and one bulrush species.

2 Understory varies among gravel pavement or mud devoid of vegetation (20%), sparse saltgrass, wheatgrass, and cheatgrass (50%), or dense foxtail, saltgrass, wheatgrass, and wildrye (30%).

TABLE 3-5
KNOWN CULTURAL RESOURCES WITHIN THE PROPOSED ACTION
AND ALTERNATIVES PROJECT AREA

Site/ Isolated Find No.	Type	Cultural Period	NRHP Eligible	Management Records	Recording Institution	Date Recorded
5RB319	Open campsite	?	Potential	None provided [1]	CSU-LOPA	1976
5RB390	Open lithic/ historic camp	Prehistoric/ historic	No	No further work	CSU-LOPA BLM	1976 1985
5RB392	Open lithic	?	No	No further work	CSU-LOPA	1976
5RB394	Open campsite	?	No	No further work	CSU-LOPA	1976
5RB396	Open lithic	?	No	Test if threatened	CSU-LOPA	1976
5RB398	Open campsite	Late Prehistoric	Eligible	None provided [1]	CSU-LOPA	1976
5RB400	Open camp	?	Potential	Test	CSU-LOPA BLM	1976 1985
5RB408	Open lithic	?	No	Test if threatened	CSU-LOPA	1976
5RB410	Open campsite	?	Yes	None provided [1]	CSU-LOPA	1976
5RB558	Open lithic	Archaic	Not given [2]	None provided [1]	DU	1975
5RB596	Open lithic	?	Not given [2]	Mitigate if threatened DU	1975	
5RB646	Historic Homestead	Historic	Not given [2]	Test if threatened	Centuries	1976
5RB1876	Wickiup		Need data	Avoid/test	GRI	1980
5RB1877	Open campsite	Archaic	Potential	Avoid or plane table map-surface collect, test prior to disturbance	GRI	1980
5RB1880	Open campsite	Archaic?	No	Avoid or plane table map, surface collect, test prior to disturbance	GRI	1980
5RB1886	Rock Shelter	?	Potential	Avoid	GRI	1980
5RB1887	Rock Shelter	?	Potential	Avoid	GRI	1980
5RB1895	Hearth	?	Potential	Avoid	GRI	1980
5RB1900	IF-1 flake	?	N/A	None provided	GRI	1980
5RB1901	IF-Biface fragment	?	N/A	None provided	GRI	1980
5RB1903	IF-Uniface flake	?	N/A	None provided	GRI	1980
5RB1906	IF-Interior flake	?	N/A	None provided	GRI	1980
5RB1907	IF-Mano	?	N/A	None provided	GRI	1980
5RB1910	IF-4 flakes	?	No	None provided	GRI	1980
5RB1912	IF-Core	?	N/A	None provided	GRI	1980
5RB1913	IF-1 flake	?	No	None provided	GRI	1980
5RB1917	IF-Mano 2 flakes	?	N/A	None provided	GRI	1980
5RB1923	Paleontological	N/A	Potential	Test prior to disturbance	GRI	1980
5RB2500	Open campsite	?	Not given [2]	Avoid	GRI	1983
5RB2502	IF-1 flake	Fremont?	N/A	None provided	GRI	1983
5RB2614	IF-point fragment	Archaic	N/A	None provided	GRI	1984
5RB2615	IF-point fragment	Archaic	N/A	None provided	GRI	1984
5RB2616	IF-interior flake	?	N/A	None provided	GRI	1984
5RB2617	IF-mano fragment	?	N/A	None provided	GRI	1984
5RB2618	IF-point fragment	Late Prehistoric	N/A	None provided	GRI	1984
5RB2619	IF-cut/burnt bone	?	N/A	None provided	GRI	1984
5RB2734	IF-5 flakes	?	N/A	None provided	GRI	1985

[1] These sites will have to be relocated and recommendations made for management.

[2] These sites will have to be relocated and reevaluated for Register eligibility.

3. TEXT CHANGES

Page 4-3

(11)

Column 1, paragraph 5, sentence 1: ". . . however, there will a potential . . . ." should read: ". . . however, there will be a potential . . . ."

Page 4-5

(11)

Column 1, paragraph 3, sentence 6: "The rock quality of the majority of the stratigraphic . . . surface to the Mahogany Zone . . . ." should read: "The rock quality of the stratigraphic . . . surface to the middle Mahogany Zone . . . ."

(11, A)

Column 1, paragraph 3, sentence 7: "Both caving because of . . . the overlying strata." should read: "Caving because of . . . the strata directly overlying the cavities."

(11)

Column 2, paragraph 1, sentence 2: ". . . would also increase." should read: ". . . would also increase, until the critical width (approximately 1,000 feet) is reached. The critical width is the least width of the mined area at which point the full load on the pillars would be felt. This would involve approximately 44 cavities, or 4 years of production under the Proposed Action."

(11)

Column 2, paragraph 2, sentence 2: ". . . some crushing (failure) at the tops . . . ." should read: ". . . some crushing (squeezing) at the tops . . . ."

(11, A)

Column 2, paragraph 2, sentence 7: ". . . the cavities up into the leached zone." should read: ". . . the cavities, extending into the leached zone."

Page 4-8

(11)

Column 1, paragraph 4, sentence 8: "Sodium resources within the L-5E Bed could . . . ." should read: "Sodium resources within the affected area of the L-5E Bed could . . . ."

Page 4-8 through 4-13

(6 thru 14, A)

Section 4.4, Water Resources has been reprinted.

4.4 WATER RESOURCES

4.4.1 Surface Water Quantity

The consumptive use of water under the Proposed Action or project alternatives would affect the quantity of water available in Yellow Creek and Piceance Creek for other uses. Water would be used for production, processing, domestic purposes, and for the filling of the mine cavities after mining has been completed. The cavities (void spaces) left by removal of the sodium would contain briney water.

Project water would be supplied from an upper aquifer well located in Township 1 South, Range 98 West, Section 24, NE1/4NE1/4. The company currently has conditional water rights for 2,235 gallons per minute from this well. This well would be pumped at a maximum rate of 300 gpm, which is sufficient to supply water requirements for all alternatives except the 500,000 TPY Alternative. Additional water needs, required by this alternative, would have to be supplied from a yet-to-be-identified source. WRC has conditional water rights for an additional 15,645 gallons per minute from other wells in the area. The total water usage would vary by alternative (Table 4-3).

Wright Water Engineers (1985) conducted hydraulic simulations to determine surface water impacts associated with the pumping of the single water supply well in Section 24 (Table 4-3). The pump rates would not cause any measurable reduction of flow in Yellow or Piceance Creek under the No Action Alternative, but would cause a reduction of average daily flow in Yellow Creek of 2 percent (.04 cfs) for the 50,000 TPY Alternative, 3.2 percent (.06 cfs) for the Proposed Action (125,000 TPY), and 15.3 percent (.29 cfs) for the 500,000 TPY Alternative (Table 4-3). Piceance Creek would be depleted by .1 percent (.04 cfs) for the 50,000 TPY Alternative, .3 percent (.10 cfs)

TABLE 4-3

WATER QUANTITY EFFECTS

	No Action	50,000 TPY	Proposed Action	500,000 TPY
Pumping Rate (gpm)	60	80.00	109.00	436.00
Annual Water Use (acre-ft)[a]	93	124.00	169.00	674.00
Total Use for Mine Life (acre-ft)	186	3,720.00	5,070.00	20,220.00
Water Left in Cavities (acre-ft)	13	574.00	1,404.00	5,615.00
Water Left in Cavities with Subsurface Fly Ash Disposal (acre-ft)[d]	13	574.00	1,404.00	5,488.00
Depletion in Flow from Yellow Crk (cfs)	None	0.04 [b]	0.06 [c]	0.29 [c]
Percent of Average Daily Flow	None	2.00	3.20	15.30
Depletion in Flow from Piceance Crk (cfs)	None	0.04 [b]	0.10 [c]	0.51 [c]
Percent of Average Daily Flow	None	0.10	0.30	1.90

[a] Assumes pumping at specified rate for 24 hours per day, 350 days per year.

[b] Assumes that 50 percent of the pumping will be stream depletion and that the effect will be evenly divided between Piceance Creek and Yellow Creek.

[c] Stream depletion after 30 years of pumping modeled by Wright Water Engineers (1986).

[d] Fly ash disposal is considered under the 500,000 TPY Alternative only.

for the Proposed Action (125,000 TPY), and 1.9 percent (.51 cfs) for the 500,000 TPY Alternative. (For a discussion on the significance of these depletions, please see Section 4.4.6, Water Uses and Water Rights.) These reductions would take place gradually, with full depletion obtained 25 to 27 years after mining begins. These depletions could persist for many years after pumping has stopped, until surface and groundwater systems recover to natural conditions. These projected depletion rates could substantially change if a second water supply well were incorporated to satisfy production requirements for the 500,000 TPY Alternative. Pumping rates and location of this second well would compound the effects of drawdown on the upper aquifer and the associated depletion of the surface waters. Therefore, additional hydraulic simulation and analysis will be required to further determine surface water impacts prior to approval of the 500,000 TPY Alternative.

The depletion amounts shown in Table 4-3 are based on mathematical modeling of the cone of depression for the upper aquifer from a single well source (William H. Bellis 1986). The scope of model simulations are limited by the structure of the model, the availability of site specific detailed data, and annual and seasonal variations of natural conditions. Additional field data are needed to accurately verify predicted depletions and their significance. Therefore, BLM will require that springs and stream flows of Yellow and Piceance creeks, potentially affected by these depletions, be inventoried by WRC and monitored on a regular basis, prior to and during mining operations. Monitoring will include water quantity and quality of stream flow above and below lease boundaries, and all springs within the cone of depression.

4.4.2 Surface Water Quality

Surface water quality could be degraded by an increase in sediment delivered to the stream associated with sodium project construction/operation or by a spill of brine from mine operations.

The mine site is located at least 2 miles of ephemeral stream distance from any perennial water. The interim revegetation standards proposed in the reclamation section should also quickly stabilize the soils. It is, therefore, unlikely that any significant increase in sediment yield would occur in either Yellow or Piceance Creek under any alternative.

To mitigate possible impacts to surface water, the mine operator has proposed to install leak detection alarms on all surface piping. Also, the piping has been designed so that it can be drained to the evaporation ponds before it is moved. Visual inspections of the piping system are also planned. These precautions would limit any leaks of brine from the piping to small amounts. The mine facilities would be built on concrete slabs and drained via a sump system

to the evaporation ponds. This would effectively contain any spills in the plant.

Degradation of surface water quality from brine spills would only take place if the evaporation ponds leaked or overflowed. The evaporation ponds have been designed with dual liners and a leak detection system, and any leaks that are detected will be repaired. During exceptionally wet weather when there is no effective evaporation, the ponds could over top, releasing fluids to ephemeral drainages of Yellow Creek. This potential impact will be mitigated by requiring that the evaporation ponds be maintained with adequate free board. This could be accomplished by hauling waste water to other approved sites, building additional ponds, or using waste heat from the mine to increase the rate of evaporation. In addition, residual solids will be periodically removed from the evaporation ponds and hauled to an approved landfill for disposal.

Consideration was given to alternative methods of waste water disposal. Hauling all waste water from the mine site would eliminate the need for evaporation ponds. Disposal of the water hauled from the mine could be accomplished by alternative methods such as deep well injection, evaporation, or cycling through a water treatment facility. All of these alternatives would require more energy than on-site disposal. They cannot be fully analyzed because alternate disposal facilities do not exist; however, the impacts associated with these alternative methods would be similar to the impacts of the proposed on-site facilities, except that water treatment facilities are generally designed to remove organic pollutants but rarely are designed to remove salts. Based on these concerns, there probably would be no benefit gained from requiring the off-site disposal of waste water. There would be a small benefit to allowing the on-site disposal of waste water, because less energy would be used by on-site evaporation, and potential impacts would be localized.

In summary, the risk of significant impacts occurring to surface water quality would be very low if the mine is operated as planned. This low risk would be further reduced by requiring that the evaporation ponds be maintained with adequate free board. As such, there should be no significant impact to surface water quality from surface operations under any of the alternatives. See the Groundwater Quality section for projected and potential surface water quality impacts from subsurface mining operations.

4.4.3 Groundwater Quantity

Groundwater quantity would be directly affected by the pumping of water from the upper aquifer for project needs. The amount of water removed from the upper aquifer by alternative is shown in Table 4-3. This would be an insignificant percentage on lease and basin wide of the amount of groundwater in storage for all alternatives. However, from a water rights standpoint, any measurable depletions would be considered significant (see Section 4.4.6 for a discussion of these impacts). Local effects to vested water right holders would be mitigated by a water augmentation plan administered by the State of Colorado. It may require many years from the end of the project life for the aquifer system to recover and to fully replace, through natural recharge, the amount of water removed from storage during sodium mine operations.

Subsidence effects on groundwater quantity are expected to be negligible to the hydrologic system and relatively isolated to the base of the lower aquifer. As stated in the draft EIS, Section 4.2.2, Rock Quality, caving of the mined cavities is expected to occur up through the dissolution surface into the base of the lower aquifer under all commercial-scale alternatives. Additional subsidence effects are expected from the downward movement of the overlying formations; the Mahogany Zone (semiconfining layer) would experience some movement, although significant fracturing is not expected.

These subsidence effects could allow some increased communication from the upper aquifer to the lower aquifer, and would establish additional communication between the Saline Zone and the base of the lower aquifer. This would result in small volume changes within the hydrologic system with no expected net loss of water quantity to the system from subsidence; therefore, subsidence impacts to groundwater quantity are not considered significant.

In a report prepared for WRC, Weston (1985) investigated the effects of a high degree of fracturing to the formations overlying the solution cavities due to subsidence from the proposed mining operation. This report projected that the hydraulic head of the perched aquifer within the upper aquifer would drop by 30 feet, and that the hydraulic head of the remaining portion of the upper aquifer and lower aquifer would raise by about 3 feet. These effects would be caused from an increase in communication between the aquifers. Although there would be no net loss of water within the system, the strata of the perched aquifer would be dewatered down into the remaining portion of the upper and lower aquifers. Since the recharge rate of the perched aquifer is considered quite low, this zone would be severely reduced or lost as a viable water source for livestock and/or domestic use. This report assumes the worst case hydraulic effects from subsidence. BLM's analysis predicts that the hydraulic effects from subsidence would probably not be as extensive as portrayed in Weston's report; however, monitoring will be utilized to verify predicted impacts to the groundwater system.

It is important to note that the extent and rate of subsidence and its resulting effects on groundwater quantity have been analyzed and predicted with the best available information. However, since the predicted impacts of subsidence on the

hydrologic system have not been measured in actual field conditions, monitoring of the perched and the A-groove of the upper aquifer, and the B-groove and base of the lower aquifer will be required prior to and during mining operations to verify predictions and quantify impacts. Lower aquifer zones will require more frequent monitoring than upper aquifer zones until such time that subsidence is detected and quantified. At such time, the authorized officer may require more frequent monitoring in the upper aquifer.

4.4.5 Groundwater Quality

4.4.5.1 Common to All Alternatives

The most significant potential impact to water resources from the sodium mine operations would be to groundwater quality. This impact could occur as a result of brine leaking through well casings, improper hydraulic seal between the mine cavity and the lower aquifer, and through breaching of a solution cavity during collapse of the mine zone. There is also the slight potential that the perched aquifer would be contaminated by percolation from the septic system leach field. However, because the surface recharge and permeability of the Uinta Formation on lease is low and the distance from the leach field to water in the perched aquifer zone of the upper aquifer would be 300 to 400 feet, the risk of contamination to the perched aquifer is very low.

Contamination of the aquifers could occur from the breaching of a well casing because of corrosion or improper installation and failure of the hydraulic seal between the cavities and the lower aquifer. If this happened, saline brines could leak into the groundwater system. WRC's proposed leak detection system for the production wells, as described on page 2-8 of the draft EIS, Section 2.2.12.2, should detect any leak in excess of 3 gallons per minute (Jones 1985). If a leak were detected, use of the well would be suspended until repaired, and significant impacts to the quality of the groundwater should not occur.

Casing leaks into the upper aquifer are not expected to be a problem, because the proposed operating procedures would not allow mining fluids to rise up into the annular region of the casing within the upper aquifer.

Casing leaks (less than 3 gpm) in the upper part of the lower aquifer would be undetected by WRC's proposed groundwater monitoring system, because it would only measure the base of the lower aquifer. Over the life of a cavity, this could cause the introduction of a significant amount (about 1 acre-foot) of brine into the lower aquifer of the groundwater system. This potential impact necessitates the monitoring of the B-groove and base of the lower aquifer. This will ensure that all casing leaks are detected and that remedial actions, such as well repair, can be taken before significant impacts to groundwater quality occur.

Potentially significant impacts to groundwater quality would occur as the result of expected mine cavity roof collapse under the commercial-scale alternatives. As predicted in this analysis, the collapse zone would extend 53 feet above each cavity up through the dissolution surface (Rock Quality section). This would establish a physical connection between the base of the lower aquifer and the brines in the cavities resulting in an increase in the area at the base of the lower aquifer in contact with saline minerals. This could significantly degrade the water quality at the base of the lower aquifer by increasing the total dissolved solids concentration.

WRC believes that the likelihood of a physical connection occurring between the mine zone and the groundwater system would be low because of the presence of the "rubber beds" and competent oil shale between the mine zone and the base of the aquifers. Although the "rubber beds" may have some mitigative effect, they are thin and would weaken when subjected to thermal conditions of the solution mining process, and therefore, would probably not be effective at sealing the mine cavities from the base of the lower aquifer if roof collapse occurred. This analysis predicts that roof collapse would take place in a gradual manner over all cavities under commercial-scale development (see the Rock Quality section in the draft EIS).

Assuming this, if hydraulic communication were established between the mine cavities and the lower aquifer, the brines within the cavities would naturally tend to remain isolated from the water in the base of the lower aquifer, because the brines would be more dense and more viscous than these waters. Each collapsed cavity would be a steep sided basin in the base of the saturated zone, causing the brines to remain ponded in the cavities. The water of the lower aquifer would tend to stratify with the brines in the cavities. Mixing of the lower aquifer and brines would occur by continuous groundwater flow across the cavity tops, natural dissolution, and diffusion. These processes, which would take place at very slow rates, would cause an increase in total dissolved solids at the base of the lower aquifer. More significant impacts to the quality of the lower aquifer could also occur in the unlikely event of a catastrophic or rapid roof collapse. This would take place over several hours and could be fast enough to cause turbulent conditions within the collapse zone. These conditions could allow for a more rapid mixing at the base of the lower aquifer with the brines in the cavity. Over the very long term (200 to 1,000 years), this could cause an increase in dissolved solids to the White River by as much as 5.0 mg/l or a maximum of 1 percent for the 500,000 TPY Alternative. This would be a total of 10,270 tons per year contributed to the Colorado River or an increase of .935 mg/l at Imperial Dam (Progress Report No. 12, USDI, Bureau of Reclamation 1983). However, as previously stated, this analysis predicts gradual roof collapse, not rapid roof collapse.

3. TEXT CHANGES

In a report prepared for WRC, Weston (1985) predicted a mixing of the upper and lower aquifers due to a high degree of fracturing from subsidence. Based upon the high degree of fracturing portrayed in Weston's report, the following impacts would be expected. Mixing of the perched aquifer zone with the confined portion of the upper aquifer would be considered a significant impact, because the water quality in the perched zone usually meets state drinking water standards, whereas the confined portion of the upper aquifer more often exceeds these standards. Thus, the perched aquifer would be lost as a viable groundwater source. The mixing of the upper aquifer water with the lower aquifer water would not be considered as significant, because these zones have similar water quality and, if the vertical hydraulic gradient remained downward, the lower aquifer quality could be marginally improved. However, the rise in water levels in the lower aquifer at the mine site may steepen flow gradients away from the mine, and could result in more rapid transport of saline minerals from the mined out cavities. An extensive monitoring system (Appendix C) will help verify that the actual impacts to the groundwater system are not as great as predicted in Weston's report.

Water for production will be supplied from a well in Township 1 South, Range 98 West, Section 24 for all alternatives except the 500,000 TPY. Limited data indicates that the Mahogany Zone has more vertical permeability on lease than in other portions of the basin, thus it is of limited effectiveness as a confining or separation zone between the upper and lower aquifers (Wright Water Engineers and Daub & Associates 1985). If the vertical permeability across the Mahogany Zone is as predicted by WRC, then drawdown at the water supply well in Section 24 would induce a small but detectable reverse flow gradient with lower aquifer water moving upward through the Mahogany Zone into the upper aquifer. This would be reflected in a quality change of the water in the supply well. Over the life of the project, this would produce a lowering of the water quality in the upper aquifer in the area immediately surrounding the water supply well. This would also hold true for additional water supply wells needed for production water under the 500,000 TPY Alternative.

To insure that the hydrologic system reacts similar to the predicted assumptions and to mitigate against potentially significant impacts, monitoring of water quality will be required in the perched aquifer and A-groove of the upper aquifer, as well as the B-groove and the dissolution surface of the lower aquifer. All aquifer zones will be monitored for baseline conditions 6 months prior to well drilling/ solution mining operations and will be continuously monitored during mining operations. If subsidence effects and/or increased dissolved solids are detected in the lower aquifer, the upper aquifer zones may require more frequent additional monitoring.

If the dedicated groundwater monitors detect increased dissolved solids above the State of Colorado groundwater quality standards entering the system, remedial action will be required (Appendix C). These remedial actions will have to be designed to remove and/or isolate the brine from the rest of the aquifer system. A technique that may be used is the pumping of the brines for surface disposal. The number of dedicated groundwater monitoring wells needed will vary by alternative, depending on the size of the well field. (See discussion below.)

In the event mitigation failed to provide intended results, the following significant impacts could occur. There would be increased total dissolved solids entering the lower aquifer from natural dissolution and diffusion at the well field, and eventually moving into Piceance and Yellow creeks, and finally to the White River. Table 4-3A shows estimates of these increases. The estimates assume that one-half of groundwater flow across the mine area goes to each stream and the TDS concentration is expressed as a range due to uncertainties concerning natural versus post-mining dissolution rates (Robson and Saulnier 1981).

TABLE 4-3A
PREDICTED SALINITY INCREASES (UNMITIGATED)

Alternative	TDS Increase (mg/l)	% Increase from Average
YELLOW CREEK		(2,520 mg/l)
50,000	Less than 1 to 70	Less than 1 to 2.7
125,000	2 to 160	Less than 1 to 6.5
500,000	6 to 600	Less than 1 to 25.0
PICEANCE CREEK		(1,800 mg/l)
50,000	Less than 1 to 5	Less than 1
125,000	Less than 1 to 15	Less than 1
500,000	Less than 1 to 50	Less than 1 to 3

It is important to note that this analysis is based on the assumption that the dissolution surface is a dynamic feature and that the solution of nahcolite is an active natural process in the Piceance Basin. The alternate assumption is that the dissolution surface is a stable feature and only minimal nahcolite dissolution is presently taking place. If this is correct, there is the low possibility that the stability of the dissolution could be upset and a new epoch of nahcolite dissolution would be initiated. If this were to happen, the long-term impacts to the quality of the lower aquifer could be much greater than those projected here. There is a low probability that this scenario would occur, and monitoring will detect changes in water quality so remedial actions can be applied.

The following discussion is provided to better define possible effects to the water quantity and quality of the hydrologic system on lease from well completion and abandonment.

WRC proposes to drill and complete 11 production well pairs (22 wells) per year over the life of the project. Each well would be completed by cementing the bottom 100 feet and by placing a chemical gel-type mud (casing pack) behind the outside 8 5/8-inch casing to surface. The 100-foot cement column would extend from the Boies Bed upward into the lower aquifer.

Upon abandonment of the borehole, the casing above the cemented area would be removed and used for subsequent wells. A cast iron bridge plug would be set just above the casing shoe and 100 to 150 feet of cement placed upon the plug sealing off the Saline Zone from the lower aquifer. Additional plugging would be accomplished by placing chemical gel type mud (casing pack) from the top of the cement to within 65 feet of the surface where a cement plug would be set.

Cementing the bottom 100-foot interval of the production casing is to provide a hydraulic seal between the production cavity and the lower aquifer, thereby guarding against upward movement of brines into the lower aquifer, and also to provide stability to the well bore and casing string. Taking into account the technical concerns of placing the 100-foot cement column and the cement to formation bond, coupled with the stress placed on the well strings from horizontal drilling within the cavities and other operational procedures (Appendix B), there is probable concern that effects might occur to the lower aquifer during production of the solution cavities. Should the cement column remain intact and provide an adequate hydraulic seal between the cavity and the base of the lower aquifer, then no impacts would be expected. However, if the reverse were true, increased dissolved solids would communicate into the base of the lower aquifer degrading the aquifer quality. As stated previously, as the mine progressed and predicted caving occurred, direct communication between the base of the lower aquifer and the cavities would be established, thereby increasing the likelihood of lower aquifer degradation. Cavity collapse and/or subsidence in itself would not exclude concern for proper isolation between the Saline Zone and the lower aquifer. Therefore, adequate monitoring of the dissolution surface will be required so that changes in total dissolved solids of the lower aquifer can be detected during production phases over the life of the project.

For production well completion, casing pack would be placed between the outer casing and the formation rock for the proposed 22 wells per year under the Proposed Action as proposed by WRC. This casing pack would be subject to dynamic well bore conditions that might compromise its intended function to isolate and insure aquifer integrity. Production wells would be online from 90 to 120 days. Although all wells would be drilled and completed at approximately the same time, they would not necessarily be put into production concurrently. Therefore, many wells may be in nonuse for several months after completion. The use of casing pack is proposed by the applicant in place of cement to allow the removal of well casing for reuse and economic considerations. Assuming the casing pack functions as WRC predicts and flow gradients are in the downward direction, no impacts to the aquifer systems would be expected from this action. Should the casing pack dissipate or not seal the zones as predicted, then any increased movement of upper aquifer water to lower aquifer water would not adversely effect water quality under any of the alternatives. Although upper aquifer water would flow in the downward direction to the lower aquifer resulting in small volume changes, no net loss to the hydrologic system is expected. However, if the flow gradient were reversed, lower to upper, because of stress on the system from subsidence and/or from pumping of the production water supply well(s) under any of the commerical-scale alternatives, then upper aquifer water would be impacted by slightly poorer water of the lower aquifer. This degradation could exceed the State of Colorado groundwater quality standards (Colorado Water Quality Control Commission 1987). Therefore, BLM will require that the A-groove above the Mahogany Zone and the B-groove below the Mahogany Zone be monitored to ensure aquifer integrity. In addition, BLM shall require that a cement plug be set across the Mahogany Zone upon well abandonment. Frequency of monitoring will be dependent and variant upon production and subsidence effects to the aquifer systems.

4.4.5.2 No Action Alternative

Up to three cavities will be constructed under the No Action Alternative. The groundwater monitoring system required for the pilot project should detect any significant increase in dissolved solids entering into the groundwater system in sufficient time for remedial action to be taken.

Therefore, no significant impacts to groundwater quality will occur under this alternative.

4.4.5.3 Proposed Action

The major difference between the alternatives, as they potentially affect groundwater quality, would be the number of cavities constructed by each alternative. Under this alternative, 330 cavities would be mined. Thus, there would be a greater number of cavities that could fail.

If all of the cavities collapsed, the area at the base of the aquifer in contact with saline minerals would increase up to 20 percent within the leases; however, this would only be about a 1 percent increase over the total area of the base of the groundwater system in the basin that might be in contact with saline minerals. This could result in an increase in total dissolved solids concentration higher than the state standard in the lower portion of the lower aquifer within the vicinity of the leases. If remedial measures were unsuccessful in mitigating (alleviating) this impact, it would be locally significant and could be regionally significant.

4.4.5.4 50,000 TPY Alternative

Under this alternative, 135 cavities would be mined over the project life. If all of the cavities collapsed, the area at the base of the groundwater system in contact with saline minerals would increase by less than 10 percent within the leases; however, this would be less than .5 percent increase over the total area of the base of the groundwater system in the basin that might be in contact with saline minerals. If remedial measures were unsuccessful in mitigating (alleviating) this impact, it would be locally significant.

4.4.5.5 500,000 TPY Alternative

Under this alternative, there would be the greatest risk that an impact to the quality of the groundwater could occur, because of the larger number of cavities that would be mined (1,320) and because the well field extends to the boundary where the Boies Bed is truncated by the dissolution surface. In this area, which is to the southwest of the plant site, the base of the groundwater system intersects the mine zone. This means that any roof collapse, even of a few feet, could establish a hydraulic connection between the base of the lower aquifer and the brines of the cavities.

If all of the cavities collapsed, the area at the base of the groundwater system in contact with saline minerals would increase by about 80 percent within the lease boundaries; however, this would be only about a 4 percent increase over the total area of the base of the aquifer in the basin that might be in contact with saline minerals. This could result in an increase of total dissolved solids concentration in the lower portion of the lower aquifer within the vicinity of the leases. If remedial measures were unsuccessful in mitigating (alleviating) this impact, it would be both locally significant and could be regionally significant.

Under this alternative, coal would be used as an energy source. This would generate fly ash, which would require disposal. Two proposals have been made for fly ash disposal: disposal on the surface in clay lined pits or pumping the fly ash into completed mine cavities.

The first method would effectively isolate the fly ash from the hydrologic system. Over the very long-term (5,000 plus years), this material could be exposed by erosion. The pile could then cause adverse impacts to the surface water quality. The second method would displace water from the mine cavities, reducing the amount of brine underlying the groundwater system. Generally, either method of fly ash disposal would be unlikely to cause significant environmental impacts; however, disposal of fly ash in abandoned mine cavities could generate some small benefits to the environment. Based on this, subsurface disposal of fly ash would be preferred.

4.4.6 Water Uses and Water Rights

Because the surface water system in the Piceance Basin is over allocated, any measurable depletion in surface water flow, as expected under all commercial-scale alternatives, would be considered significant—especially during periods of irrigation and/or low surface flow.

Groundwater depletions, from pumping the water supply well(s), may alter the water levels in appropriate stock and domestic wells within the cone of depression. Mining operations may also alter water quality in the aquifer system, thus altering quality levels within the wells. These impacts are considered significant.

State law requires that adverse effects to vested water rights holders be mitigated through a water augmentation plan, administered by the State of Colorado.

4.4.7 Monitoring Summary

The wide range in potential impacts on hydrology, coupled with a high degree of uncertainty as to the magnitude and significance of these impacts, require that a well designed and intensive monitoring system be in place prior to and during operations. This is further supported by the existing sodium lease terms which explicitly require protection of the groundwater resources.

The major function of a hydrologic monitoring system is to detect and measure changes due to mining operations. In order to do so, the monitoring system must be designed to accomplish several objectives, including (1) provide additional needed information on the natural, premining

hydrologic conditions, (2) provide a continuing documentation and factual record of any changes due to lease operations, and to allow separation of these changes from natural hydrologic changes in the area, (3) provide continuing check on compliance with lease terms and with other applicable laws and regulations, (4) provide early-on notice of any detrimental effects or conditions that require further mitigation or control measures, (5) provide a check on the efficiency of mitigation and control measures, and (6) provide factual basis for any needed revisions to the monitoring system.

In order to measure potential effects on surface flows and water quality, monitoring stations are needed upstream and downstream on the main channel of Yellow and Piceance creeks. Surface water monitoring should include continuous flow, precipitation, and comprehensive water quality analysis for major and trace constituents. The intensity of monitoring water quality probably can be reduced following a few years of data collection and analysis.

A groundwater monitoring network is required to further refine knowledge of the groundwater system (e.g., aquifer anisotropy), and to detect and quantify as early as possible any hydraulic and water quality affects from project operations. The monitoring network will require an adequate number of properly constructed wells to monitor several aquifer zones at the mining site and vicinity. Four zones of critical concern are; (1) the bottom 20-50 feet of the lower aquifer, which probably will be the first zone affected by the mining operation and by caving of cavities, (2) the B-groove, which will reflect any upward migration of hydraulic effects in the bottom zone noted above, as well as reflect leakage through the Mahogany Zone both from the supply well and from subsidence, (3) the A-groove, where the most pronounced effects at the mine site of pumping from the supply well will occur. These effects will need to be separated in the interpretation of data from effects of leakage across the Mahogany, and (4) the perched aquifer in the Uinta Formation, which will reflect both subsidence effects and inflows from the surface that may degrade water quality. Monitoring all of these zones will also serve to detect and locate leakage of brine from production wells and/or cavities. In order to be effective, monitoring wells should not be open to more than 50 feet of aquifer section, and effectively sealed from any communication with other zones, and in place 6 months prior to mining operations. Detailed monitoring of subsidence is also necessary in order to evaluate cause-effect relations between subsidence and changes in aquifer properties and in water levels.

Details of the groundwater monitoring system for the commercial phase operation, can best be established after initial data are collected and analyzed from the pilot project operations. Refer to Surface and Groundwater sections of the Environmental Consequences for expected impacts and further justification of this monitoring rationale.

Page 4-13

(11)

Column 2, paragraph 2, sentence 1: "Spills of nahcolite pregnant solution could occur . . . ." should read: "Spills of pregnant solution (sodium bicarbonate) could occur . . . ."

(11)

Column 2, paragraph 2, sentence 2: "Surface spillage of nahcolite would . . . ." should read: "Surface spillage of sodium bicarbonate would . . . ."

(11)

Column 2, paragraph 2, sentence 5: ". . . soils from possible nahcolite spillage . . . ." should read: ". . . soils from possible sodium bicarbonate spillage . . . ."

Page 4-19

(14)

Column 2, replace paragraphs 1, 2, and 3: "No significant alteration or reduction of waterfowl habitats in Piceance or Yellow Creek would occur as a result of the No Action, 50,000 TPY, or 125,000 TPY alternatives. Palustrine wetlands comprising dense nesting and brood cover, and forage provided by aquatic vegetation and macroinvertebrate populations are not expected to be measurably impaired. Reductions in surface water availability would be most pronounced during the winter low flow period. Average flow reductions during the mid-winter occupation period (November-January) would not normally exceed 6 percent and would not be expected to significantly reduce the areal extent of suitable winter habitat.

Implementation of the 500,000 TPY Alternative could induce notable reduction or degradation of waterfowl habitats existing in lower Yellow Creek. Flow reductions during the nesting season (May-July) may average 15 to 30 percent, and over time, could lead to major losses or alteration of dense streamside vegetation as nesting or brood cover. Average fall and winter flow losses of 20 to 30 percent would substantially reduce stream depth and tend to accelerate the formation and prolong the persistence of ice cover, thereby reducing the extent of surface water availability for winter waterfowl use.

3. TEXT CHANGES

Wetland and waterfowl related impacts associated with the 500,000 TPY Alternative would persist through mine life, and to some degree until aquifer recharge. However, the applicant would be subject to fully compensating waterfowl habitat value lost as a result of groundwater pumping (see revisions to Section 2.4.1.1.8)."

Page 4-20

(14)

Column 1, paragraph 3, sentence 2: "The groundwater depletions (as shown in Table 4-3) although significant from this specific project, would ultimately reduce surface water volumes in the White River and downstream endangered species' fisheries due to the cumulative effects of all the projects in this area." should read: "Groundwater depletions shown in Table 4-3, although regionally insignificant for this individual project, would contribute cumulatively to reduced surface water volumes in the White River and downstream endangered species fisheries in association with other projects in the area (see Section 2.5, Baseline)."

(14)

Column 1, replace paragraphs 5 and 6: "Animal populations associated with Yellow Creek's palustrine wetlands would not be influenced by small compositional changes projected for in-channel emergent vegetation under the No Action, 50,000, and 125,000 TPY alternatives (see Section 4.9.6).

Flow depletions projected for the 500,000 TPY Alternative have the potential to reduce or alter shrub-scrub and emergent wetland components by an appreciable, but undetermined degree (see Section 4.9.6). Structurally or compositionally unique habitat elements exist in the form of tamarisk stands (approximately 5 acres) and the narrow obligate emergent zone composed of sedges and bulrush adjacent to Yellow Creek's streambed (approximately 18 acres). Small existing populations of species dependent on these features, including yellow warbler, yellowthroat and song sparrow, could very well be subject to many years of habitat reduction and displacement. However, wetland related mitigation requirements (see Section 2.4.1.1.8) should adequately compensate these habitat losses in the long-term."

(6, 11, 14)

Column 2, Section 4.9.6: Replace entire section.

4.9.6 WETLAND HABITATS

4.9.6.1 Flow Depletion Impacts

Without a complete understanding of the mechanics governing wetland systems in Yellow Creek, BLM is unable to predict precise consequences of long-term flow reductions. Assuming wetland extent, composition, and condition are a function of streamflow, any base flow reductions would be expected to alter the distribution and quantity of moisture available for wetland maintenance.

It should be emphasized that flow depletions in Yellow Creek (Table 4-7A) would develop gradually, reaching maximum rates 25 to 27 years after mining begins. Although maximum depletion rates have been applied to all calculations, interim flow loss would average 50 percent lower for the No Action, 50,000 TPY, and 125,000 TPY alternatives, and 25 percent lower for the 500,000 TPY Alternative. Depletions could persist for many years after mine life, although progressive recovery of ground and surface waters should commence soon after groundwater pumping ceases.

4.9.6.1.1 No Action, 50,000, and 125,000 TPY Alternatives

Spring and early summer flows are considered most important for plant establishment and growth—at a time when Yellow Creek's flows would be least influenced by mine-induced depletions (2 to 3 percent maximum, Table 4-7A). Average late summer flow depletions would increase slightly to 3 to 5 percent. During drought influenced years, average depletions through the entire growing season may be 5 to 7 percent, becoming most pronounced during late summer low-flow periods when 12 percent average reductions could be realized (short-term events could approach 20 percent).

BLM expects no net reduction of in-channel wetland acreage from flow loss associated with these alternatives (Table 4-7A), although small compositional changes in the herbaceous emergent zone may occur. This could appear as a linear constriction of the obligate herbaceous community along the 12.9 miles of affected stream, with compensatory expansion of facultative herbs. BLM would expect unit-for-unit "exchange" of obligate to facultative emergents, involving less than 5 percent of obligate vegetation most years, and no more than 10 percent during drought influenced years.

Spring runoff and intense summer storm flows appear to regulate the distribution of shrub-scrub wetlands by supporting the proliferation of woody species in overflow areas and restricting shrub encroachment to the high water perimeter. Since periodic and seasonal flooding would not be perceptibly influenced by mine-induced dewatering under

TABLE 4-7A
ESTIMATED YELLOW CREEK FLOW DEPLETIONS

Project Alternative	Average Seasonal Depletion [1] [2] (%)				Average Depletions through Growing Season, April-Oct. (%)		
(Tons/Yr)	Spring	Summer	Fall	Winter	All Years [2]	Normal Years [3]	Dry Years [3]
No Action [4]	Negligible				Negligible		
50,000	2	3	5	7	3.5	2.5	5
125,000	3	5	7	10	5.0	4.0	7
500,000	15	22	30	29	24.0	18.0	36

[1] Spring = March to June, summer = July to August, fall = September to October, winter = November to February.

[2] Mean of all recorded years (1974-1982).

[3] "Normal" years regarded as those displaying consistent average flow measurements through the year (water years 1974-1975, 1979-1982); "dry" years showing conspicuously below average flows through year (1976-1978).

[4] The pumping rate for the No Action Alternative (Pilot Project) would be no greater than the 50,000 TPY Alternative, but would persist for only 120 days instead of 30 years.

these alternatives, BLM expects no alterations in the shrub-scrub wetland component.

The off channel wetland situated on Yellow Creek's alluvial terrace (Table 4-7A) appears to be maintained by surface runoff from adjacent uplands, independent of impacted ground and surface water systems. BLM believes this area would remain unaffected by mining-related activities.

Sparse aquatic and semiaquatic plant populations appear in deeper pools and on stream margins and should not be influenced by flow reductions associated with these alternatives. Similarly, macroinvertebrate populations would be subject to negligible, if any, impacts. Considering the shallow rectangular profile of Yellow Creek's stream bottom, average flow reductions of 2 to 5 percent may cause commensurate decreases in water depth, but would not modify the overall extent of wetted substrate available as invertebrate habitat.

BLM considers these potential depletion-related impacts to Yellow Creek's wetland communities functionally inconsequential with respect to wildlife habitat and wetland system function.

4.9.6.1.2 500,000 TPY Alternative

Groundwater pumping associated with this alternative would be more likely to cause substantial changes in the Yellow Creek's wetland communities, but lacking detailed information on the interaction of ground and surface water systems in Yellow Creek, BLM is unable to quantify such impacts. Confounding impact analysis further is the fact that the stream depletion model used for this alternative was run having assumed all processing water would be obtained from a single well. Incorporating an additional water well (page 2-24 of draft EIS) at an undetermined location could drastically alter hydrologic effects. Additional analysis would need to be performed before this alternative was approved.

Based on the model, average flows in Yellow Creek would be reduced 15 to 20 percent during an average growing season (Table 4-7A), and up to 40 percent during drought influenced years.

Flow reductions of this magnitude could substantially reduce stream side obligate vegetation. It is conceivable that attendant changes in channel morphology (e.g., bank sloughing) brought about by long-term alterations in Yellow Creek's flow regime could augment sites available for plant establishment, allowing some degree of obligate expansion toward the streambed.

3. TEXT CHANGES

Depressed peak flows during spring and summer could reduce shrub-scrub acreage, particularly on the outer fringes of overflow areas and upper channel terraces. The shrub-scrub belt on the lower terraces would likely shift its position relative to the stream, encroaching on the upper portion of the facultative herbaceous zone. BLM would not expect shrub-scrub acreage to change by more than 10 to 15 percent, with distal greasewood and sagebrush fringes bearing the greatest impact.

Although a certain amount of streambed substrate available for aquatic plant attachment (i.e., pondweed) may become exposed under these flow regimes, the overall affect should be minor, since aquatics are typically found in deeper pools where water depths would be least affected by flow loss. Macroinvertebrate habitat would not expectedly diminish except during drought influenced years when constrictions in wetted channel width would likely occur.

4.9.6.2 Salinity

Committed mitigation provides for detection of groundwater quality changes as well as required on-lease containment of dissolved solids. If this mitigation strategy is successfully implemented, dissolved solids contributions to affected stream segments would be largely avoided.

In the event mitigation was not exercised or failed to provide intended results, the following discussion is provided.

BLM has been unable to calculate specific values for expected salinity increases to Yellow Creek attributable to mining. Increased dissolved solids transport from the saline zone is expressed as a range due to uncertainties concerning natural versus post-mining dissolution rates (Table 4-3A, Hydrology section).

Maximum expected TDS increases in Yellow Creek for all but the 500,000 TPY Alternative, would not exceed 6.5 percent. Since Yellow Creek's wetlands currently tolerate average annual TDS fluctuations of 750 mg/l, we would not expect the salinity tolerance of any wetland species to be exceeded, even with sustained maximum 160 mg/l increases.

Under the 500,000 TPY Alternative, the given TDS range becomes less workable. Maximum 600 mg/l increases would increase salt concentrations by 25 percent. Although we are not aware of the salinity thresholds for plants making up Yellow Creek's wetland association, sustained 25 percent increase (average 3,120 mg/l TDS) could effect vegetation composition shifts or decrease vegetative productivity.

Plants are generally most susceptible to the effects of salinity early in their life cycle, becoming increasingly tolerant with age. Since maximum TDS concentrations coincide with low flow periods (July, August), plant development might be expected to progress more or less normally during the first half of the growing season (high flow periods). The effects of increased salinity during the latter half of the growing season would be thus somewhat moderated, particularly since these plant associations would not then be in direct contact with surface flows. BLM also has empirical evidence that wetland communities composed of sedges and tamarisk develop rapidly along well discharge paths exhibiting constant TDS values of 5,000 mg/l.

Based on this analysis and with mitigation, we would not expect salinity changes attributable to any alternative to significantly alter Yellow Creek's wetlands, particularly those elements providing locally unique community structure and composition (e.g., tamarisk, sedges, bulrush).

Page 4-30

(11)

Column 1, paragraph 4, sentence 1: ". . . the L-5E Zone, lying . . . ." should read: ". . . the L-5E Bed, lying . . . ."

(11)

Column 1, Section 4.18.1.4, Water Resources: Replace entire section.

4.18.1.4 Water Resources

There would be the potential for an unavoidable impact to the water quality of the base of the lower aquifer because of the amount of increase in the surface area of the base of the lower aquifer in contact with saline minerals as the result of cavity collapse. This potential impact would persist for the foreseeable future (less than 100 years) and would be locally significant if the state standard for total dissolved solids (TDS) concentration was exceeded and remedial measures to lower the TDS level were unsuccessful.

Page 4-31

(11)

Column 2, Section 4.18.2.2, Water Resources: Replace entire section.

4.18.2.2 Water Resources

There would be the potential for a short-term reduction in the flow of Yellow Creek (Table 4-3) as a result of the production of water for use by the mine. This reduction in flow could exist for many years after the end of mine life. There would be the potential for a long-term impact to the water quality of the base of the lower aquifer because of the amount of increase in the surface area of the base of the lower aquifer in contact with saline minerals as a result of cavity collapse. This potential impact would persist for the foreseeable future (less than 100 years) and would be locally significant if the state standard for total dissolved solids concentration was exceeded.

Page 4-32

(11)

Column 1, paragraph 5, sentence 1: ". . . around the area would shift to . . . ." should read: ". . . around the area may shift to . . . ."

(11)

Column 1, Section 4.18.3.2, Water Resources: Replace entire section.

4.18.3.2 Water Resources

The water remaining in the cavities after production ceased would be unavailable for all other potential other uses for the foreseeable future. There would be the potential for an irreversible impact to the water quality of the base of the lower aquifer because of the amount of increase in the surface area of the base of the lower aquifer in contact with saline minerals as a result of cavity collapse. This potential impact would persist for the foreseeable future (less than 100 years) and would be locally significant if the state standard for total dissolved solids concentration was exceeded.

Page 4-33

Column 1, Section 4.18.4.2, Water Resources: Replace entire section.

4.18.4.2 Water Resources

The mine site is approximately 6 miles from the C-a Prototype Oil Shale Tract. The baseline for this environmental impact statement assumes that C-a tract will be in production while this mine is operating. The open-pit mine on Tract C-a would cause very significant impacts to the groundwater system (USDI, BLM 1985b). The dewatering that would be required for mine development could change the rate and direction of flow in the groundwater within the sodium leases. Also, dewatering the pit for C-a could dramatically lower water level and change water quality parameters at the sodium mine site. A detailed plan for the development of Tract C-a is not available. It is therefore not possible to tell with any accuracy what impacts to the groundwater, caused by C-a, would extend to the sodium leases. All that can be said is that these impacts are likely to be very significant. Impacts to the groundwater from the proposed sodium mine are analyzed against existing conditions. The development of Tract C-a, however, could change existing conditions in the groundwater system beneath the sodium leases so dramatically that impacts from the proposed sodium mine would be undefinable. The impacts related to the sodium mine are insignificant by comparison with C-a.

Page 5-3

Column 1, after Lee Stevens add: **"Jack Wenderoth**

Job Title: Hydrologist; Water Resources

Education: B.S, 1979, Forest Resources-Science Option, University of Idaho, Moscow, Idaho

Experience: Soil Scientist, Soil Conservation Service, 1 1/2 years; Hydrologist, BLM, 4 years; Natural Gas Production Specialist-Hazardous Materials and Waste, Department of Defense, 1 year; Hydrologist, BLM, 1 year"

Page 6.6-2

(13)

Column 2, paragraph 1, sentence 1: ". . . overlying a Class II mine zone . . . ." should read: ". . . overlying a Class III mine zone . . . ."

3. TEXT CHANGES

Page 8-1

(6)

Column 1, after paragraph 1 add: "Bellis, William H. March 1986. Senior Hydrogeologist, Wright Water Engineers. Letter to Edward Rosar, Industrial Resources, Inc., Carbon Copy to BLM."

Column 1, after paragraph 13 add: "Colorado Water Quality Control Commission. 1987. *The Basic Standards for Ground Water*. Section 3.11.0. Denver, Colorado."

Column 1, after paragraph 14 add: "Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-79/31. 103 pp. Washington, DC."

Column 2, after paragraph 17 add: "Parker, Jack and Associates, Inc. 1985. *Rock Mechanics and the IRI Sodium-Mining Plans*. White Pine, Michigan."

Page 8-2

Column 1, before paragraph 1 add: "Pennak, R.W. 1974. *Regional Oil Shale Study, Limnological Status of Streams, Summer 1973*. Unpublished Report. Thorne Ecological Institute. 50 pp. Boulder, Colorado."

(14)

Column 1, paragraph 2: ". . . *Suggested Practices for Raptor Protection on Powerlines—State of the Art in 1981*, Raptor Research Report No. 4, Raptor Research Foundation, Inc., c/o Dept. Veterinary Biology, University of Minnesota. St. Paul, Minnesota 55101." should read: ". . . *Suggested Practices for Raptor Protection on Powerlines—State of the Art in 1981*, Raptor Research Report No. 4, Raptor Research Foundation, c/o Carpenter St. Croix Nature Center, 12805 St. Croix Trail, Hastings, Minnesota 55033."

(11)

Column 2, paragraph 15: "Wright Water Engineers, Inc., and Daub Associates." should read: "Wright Water Engineers, Inc., and Daub & Associates."

4. APPENDICES

4.1 APPENDIX A - AMENDED DECISION RECORD FOR WOLF RIDGE CORPORATION PILOT SCALE SODIUM SOLUTION MINE

4.1 APPENDIX A - AMENDED DECISION RECORD FOR WOLF RIDGE CORPORATION PILOT SCALE SODIUM SOLUTION MINE

The decision is to amend the Decision Record of May 2, 1986, for the subject project as regards stipulation 5 in the Well Drilling, Completion, and Abandonment section within Exhibit A. The fifth stipulation is revised to read as follows:

The completion procedure will utilize 100 feet of annular cement at the bottom of the drill hole with a competent casing pack above the annular cement to surface. This procedure is authorized under the following conditions:

1. This completion technique is authorized for the initial well pair only.
2. Prior to commencement of operations, WRC submits to the District Manager, a monitoring program that addresses the following objectives:
   a. That the presence of mud gel behind the casing is detectable prior to, and after, sodium mining operations, and
   b. That an adequate hydraulic seal is maintained over the operating life of the wells.
   c. The District Manager may require that additional monitoring be performed where WRC's program appears inadequate to demonstrate whether these objectives will be met.
3. The purpose of this WRC single well pair operation is to demonstrate adequacy of the program. Accordingly, the District Manger shall be advised of all operations so that he may arrange for appropriate monitoring of operations by the BLM.
4. The District Manager may require that operations cease, or that remedial procedures be implemented at any time that his monitoring of your operations determines protection of the hydrologic or other resources is not occurring.
5. The use of mud gel for completion purposes on subsequent wells will only be considered if the monitoring results show that the material is an adequate substitute for cement and does provide an adequate seal to ensure protection of groundwater and other resources.

This stipulation is being revised based upon the review of additional information submitted by WRC which shows that a sufficient probability of achieving the resource protection required by the lease terms exists.

Stipulation number 2 regarding the plugging and abandonment procedures is upheld. The use of the mud gel in the completion technique will allow for the recovery and reuse of most of the casing. However, as required by the District Manager, cement must be used in the plugging and abandonment of these wells. [1]

The remainder of the Decision Record of May 2, 1986, is unchanged and continues to be the bureau's decision as regards the pilot project. The revision of stipulation 5 in the Well Drilling, Completion and Abandonment section of Exhibit A, as outlined above, will not result in significant impacts to the environment, therefore, an environmental impact statement is not necessary.

/s/ Cecil Roberts

State Director

September 10, 1986

Date

[1] Because of the change in the well completion stipulation, the plugging and abandonment stipulation required wording changes and now reads:

A "Notice of Intent to Abandon" will be submitted by the designated operator/lessee to the authorized officer before abandonment of any well developed within this project. The notice will contain an "as-built" diagram of the well and will describe any changes from the approved abandonment/plugging procedures. The authorized officer will review and approve or approve with modifications the notice within 15 calendar days of receipt. No special form for this notice is required. As a minimum, the following plugs will be required: 1) a steel bridge plug will be placed at the base of the production casing; 2) 100 feet of cement will be placed above this steel bridge plug; 3) a cement plug will be placed 20 feet above the Mahogany Zone down through to 120 feet into the Mahogany Zone and must be tagged to insure placement; and 4) 65 feet of cement will be placed at the surface. The intervals between the cement plugs will be filled with 9 pound/gallon or heavier mud. Other cement plugs or revised plugging procedures may be required, based on analysis of the cement evaluation logs and the temperature survey log. An appropriate surface hole location marker will be installed at grade.

4.2 APPENDIX B - TECHNICAL EVALUATION OF WOLF RIDGE CORPORATION'S (WRC) PROPOSED WELL COMPLETION AND ABANDONMENT PROCEDURES

4.2 APPENDIX B - TECHNICAL EVALUATION OF WOLF RIDGE CORPORATION'S (WRC) PROPOSED WELL COMPLETION AND ABANDONMENT PROCEDURES

The following discussion outlines the primary points of technical uncertainty and disagreement between BLM and WRC regarding well completion and abandonment as well as the underlying basis for the application of the mitigating measures found in the EA and proposed in the EIS. The discussion is limited to the technical considerations necessary to ensure a stable well bore for extraction of the subject resource and adequate isolation of the mining cavity. Any discrepancies between mitigation measures concerning the length of the annular cement column (8 ⅝-inch casing x bore hole wall) that is found in the EA and proposed for the EIS are the result of further refinement of the hydrological analysis subsequent to completion of the EA.

For background information, please refer to the draft EIS and correspondence contained in the case file on the proposed mine plan, geology, and downhole resources. However, it is important to note that the proposed operation uses new and emerging technology combined with the adaptation of existing oil and gas well drilling and completion practices. The project is further complicated by the unique subsurface environment found in the Piceance Basin.

The presence of the proper fluid behind the casing facilitates efficient extraction of the subject resource. WRC proposed to ensure a stable well bore for nahcolite extraction by cementing the bottom 100 feet of casing and leaving a "casing pack" (mud gel), in the annulus between the 8 ⅝-inch production casing and borehole, from the top of the cement to surface. Upon abandonment of the borehole, the casing not cemented would be removed and used for subsequent wells. The mitigating measures proposed in the EIS expand the length of the cement column to approximately 250 feet in total length. This requirement will ensure isolation of the mine cavity from the annular region behind the 8 ⅝-inch casing and the base of the lower aquifer.

The paragraphs below describe some of BLM's recommended cementing procedures necessary to ensure an adequate cement job. The descriptions are brief and are meant only to identify the considerations that must be analyzed prior to performing a cementing operation of this importance.

Cement selection and design must satisfy the requirements of the operation in question. For this operation, cement design must include such factors as low fracture gradients, rock quality, bonding characteristics (pipe-cement-formation), salt contamination and temperature fluctuations. Cement strength should be a concern when considering the horizontal drilling operation that will occur in each well. However, the cement will not be exposed to the pressures necessary for formation fracturing and stimulation.

There are many formulations of cements that are applicable to this type of operation. WRC identified two specific types (lite and thixotropic) in a meeting at the State Office on July 30, 1986. Some new developed types of cements (i.e., foamed, expanding, lighting additives, etc.) will also satisfy the required design criteria and are lighter than water.

Poor cement jobs can result because of a number of reasons. As discussed in the referenced papers (attached), some of these reasons and corresponding explanations are as follows:

1. Improper pipe centralization
2. Improper mud conditioning prior to cementing
3. Improper removal of mud during cementing]
4. Cement contamination by mud
5. Cement-mud incompatibility (excess viscosity at interface)
6. Loss of fluid from cement slurry
7. Gas cutting of cement prior to set
8. Lost circulation before or during cementing
9. Breakdown of zones after cementing (fallback)
10. Salt and coal sections
11. Washouts
12. Pipe surface finish
13. Improper flow regime

Consideration must be given to the effects these problem areas may induce since the well bore mechanics are such that many of these problems can and will occur in this operation.

Centralization is responsible for creating a uniform flow area perpendicular to the flow direction, increasing displacement efficiency, preventing mud channels, and generally ensuring that the cementing operation occurs as planned and results in a uniform cement sheath around the casing. During displacement, mud moves much slower in the region where the casing is closer to the borehole. If proper centralization is not employed, channeling of cement will occur.

Lost circulation (LC) will exist in this project's borehole environment. The leached zone has required even the most experienced drilling engineer to rethink the use of common drilling practices when dealing with LC if costly time delays

4.2 APPENDIX B

and potential loss of borehole are to be avoided. WRC will use LC materials in the mud when drilling through and beyond the Leached Zone. This type of mud in the hole, if not removed, is not conducive to efficient displacement of mud by the cement.

Failure to adequately remove the mud in the hole during the cementing operations may result in cement channeling and subsequent fluid migration, elevated pumping pressures, reduction in cement bonding capability, and total job failure. Prior to cementing, a reduction in fluid loss, viscosity, yield point, and gel strength of the mud will increase the displacement efficiency.

Much has been written regarding proper cementing flow regimes. Most authors agree that turbulent flow provides the highest displacement efficiencies, but with most cements, turbulent flow cannot be achieved. Plug flow was once thought to be nearly as effective as turbulent flow. However, the current trend in industry seems to indicate that the greatest possible permissible velocity, given surface equipment and downhole constraints, should be used. Laminar flow results in the lowest displacement efficiencies.

Washes, flushes, and spacers also promote displacement efficiency by thinning the mud ahead, preventing a cement-mud interface that facilitates channeling and cement contamination, removing pockets (washouts) of thick, viscous gel and the film of mud on the casing. Turbulent flow is obtained more easily with these fluids than with the cement slurry.

Although not much has been written about contact time (the time cement flows past a certain point in the well bore), many authors feel that adequate zonal isolation cannot occur without a "minimum" contact time. The greater the contact time, the greater the chances are in displacing all drilling mud from a point in the well bore and achieving a good cement job. A 10-minute contact time is recommended.

Improved displacement efficiency can be realized when pipe movement is conducted. Pipe movement is accomplished by reciprocating or rotating the pipe. If the casing is adequately centralized, hole conditions (i.e., gauge and deviation) and mud properties are good, reciprocation is the better choice of the two. Rotation adds more of a lateral motion component to the system that facilitates mud removal from the narrow side of the annulus but also induces additional stresses on the pipe.

When scratchers or wipers are installed on the casing across the cementing interval and pipe motion is used, displacement efficiency improves. The greatest benefit occurs in regions of hole washout. Scratchers help in breaking the gelled mud within washouts and increases the amount of cement flow into washouts. With a properly treated cement, removal of the mud cake during cement circulation vastly improves the cement to formation bond. However, caution must be exercised to avoid flash setting or dehydration of the cement. A low fluid loss cement will eliminate this problem. Removal of the mud cake, in the presence of mud, adds little benefit since the mud cake will be quickly replaced. Dislodged mud cake must be removed prior to cement circulation if contamination is to be avoided.

The shoe of the 8 ⅝-inch casing will be set approximately 30 feet into the Saline Zone with the cement top extending across the dissolution surface and into the Leached Zone. Rock quality data (RQD) obtained from WRC for the leased area indicates that the lower half of the 100-foot cementing interval is fractured and rubblized but maintain an RQD of 60 percent (Note: All RQD percentages presented are approximate with a simple average given for specific intervals). Portions of the remaining 100 feet are composed of nahcolite, nahcolitic halite, and nahcolitic oil shale subject to dissolution by the drilling fluid, casing pack, and cement. The RQD for this interval is 10 percent. Hole enlargements will occur across this interval making mud removal difficult.

The leached zone above the 100-foot cement top exhibits low RQD percentages; however, these percentages increase to 30 percent over an interval from 100 feet to 200 feet above the shoe of the 8 ⅝-inch casing. Additional cement bonding may occur through this interval.

An anticipated occurrence as a result of forming solution mined cavities is the collapse of cavity roofs. Caving of the overlying strata into the cavity would extend vertically until the cavity was bulked full. The predicted height of the caving is 53 feet which would extend through the dissolution surface into the leached zone. Since the bottom 50 feet of the 100-foot cementing interval presents the greatest opportunity for cement bonding, isolation of the cavity would be severely jeopardized if caving was to occur.

Subsequent horizontal drilling will occur that will further jeopardize what little integrity, if any, the 100 foot annular column of cement exhibits. Many surface casing shoes in oil and gas wells have been "wobbled off" for lack of adequate cement jobs.

Operational parameters dictate the presence of mining solution within the 8 ⅝-inch casing. Air compressed to approximately 800 pounds per square inch guage (psig) will be exerted on the 5 ½-inch by 8 ⅝-inch casing annulus to prevent mining solution from occupying the interior of the 8 ⅝-inch casing. The pressure will be monitored for possible 8 ⅝-inch casing leaks. If the pressure falls to 700 psig, casing failure may have occurred. A pressure drop of 100 psig equates to a fluid rise in the 8 ⅝-inch casing of approximately 300 feet. If a casing leak were to occur above the 100-foot column of cement and did not invoke a pressure drop greater than 100 psig, mining solution would enter the annulus and may contaminate uphole resources.

Placement of the 100-foot cement column must occur with proper borehole preparation and displacement techniques, and precise volumetric measurements, taking hole enlargements into consideration. A 100-foot column of cement does not leave much room for error given the operational difficulties with placing the cement and the importance in obtaining a good cement job. WRC did not provide much information concerning the procedures proposed to prepare the borehole and place the cement. Very few of the items listed above were identified in the mine plan. WRC claims that the 100-foot column of cement will effectively seal the mining cavity from the above annular region and support two strings (5 ½ and 8 ⅝ inches) of casing. BLM has no argument with WRC about the cement bonding necessary to support the weight of the casings; however, exception is taken to their statements about isolation of the mining cavity.

BLM believes the 100-foot annular column of cement will not provide an adequate barrier between the mining cavity and the annular region behind the 8 ⅝-inch casing. No information was provided by WRC that would justify the intended function of the cement. Therefore, increasing the total annular cement column length from 100 feet to 250 feet with confirmation of the cement job obtained by running a Cement Evaluation Tool log or equivalent log is deemed necessary and will be required.

Hole abandonment is dictated primarily by the type of completion program used. BLM has no objection to the use of mud between cement plugs within the borehole. We do, however, object to the use of mud in place of cement when attempting to permanently secure the well bore and provide resource isolation or protection. Cement will immediately ensure (within 8 hours) that a hole is adequately plugged. The regulations and lease terms do not allow approval of plugging procedures that provide temporary or speculative resource protection or isolation. The full scale commercial mine plan calls for drill holes on 300- to 600-foot spacings within cavities and 78 feet between cavities. The potential for resource contamination is magnified many times by the scale of this operation.

Plugging gel is subject to dynamic well bore conditions that may compromise its intended function for the life of the Piceance Basin. The technical expert presenting the characteristics of the plugging gel at the July 30, 1986, meeting could not provide information concerning the gel's physical properties (upon mixing and over time) except to state that if it is made properly and no fluids are flowing to the surface, adequate aquifer protection is indicated. BLM cannot base resource protection decisions on such an unsubstantiated viewpoint.

WRC provided some background into the history of the type of plugging gel they propose to use in their statement of reasons supplied with the appeal of the mitigating measures in the EA. The product analyzed was a high-quality sodium bentonite-polymer base compound (Shur-gel mud conditioner-product of NL Baroid/NL Industries Inc.). WRC proposed to use Shur-gel as their plugging gel. In almost every case (ten mineral exploration drill holes), the mud level dropped at or just above the piezometric surface of the first aquifer 6 to 10 weeks after placement. The article states that the common characteristics of the fluid after placement is a drop in fluid level to the piezometric surface. No information was provided concerning the specific downhole geology of the exploration drill holes, but it is doubtful that the geology approximates the conditions found in the Piceance Basin. What little technical data that could be obtained from the article about viscosity development seemed encouraging. However, fluid sampling techniques and consistency were questioned and the viscosity increase was termed a "tendency". Other background articles/letters recommend the use of cement, if artesian flow is encountered or if the use of a plugging gel is not adequate.

The only justification provided concerning the sealing characteristics of the plugging gel were mining intercepts of boreholes that were plugged with Shur-gel. No information about depths or formation characteristics were presented.

Therefore, considering the potential for gas migration from oil shale regions or water influx from the aquifers into the well bore, leaching of the plugging gel into vuggy, unconsolidated zones, possible future use of the aquifers, and development of the oil shale, BLM believes the plugging of critical intervals within the well bore should be accomplished with cement. If cement is used and all mud within the well bore is evacuated after abandonment, the existing cement plugs will provide the required resource isolation or protection.

The unproven technology and scale of this type of solution mining operation requires a logical progression from theory to fact. Accurate data should be obtained by applying new procedures and operations in a step-wise fashion. Thus, developing problem areas can be easily identified and corrections and modifications made quickly. If the entire scope of new technology is utilized immediately, several attempts at changing different operational aspects may be necessary before problem areas are found and corrected. Experience obtained from the first few well pairs should allow responsible modifications with sufficient justification and confidence. Part of the proposed mitigation in the EIS provides the operator an opportunity to submit for approval "any technical considerations and/or proposed changes in operation".

4.2 APPENDIX B

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4.3 APPENDIX C - BLM PROPOSED MITIGATION

4.3 APPENDIX C - BLM PROPOSED MITIGATION

The following mitigative measures and stipulations will be applied by BLM to the approved action, regardless of the alternative selected. Some measures are unique to specific alternatives and are duly noted.

All of the following stipulations have been developed as the result of a comprehensive, interdisciplinary environmental analysis and technical evaluation of WRC's five volume mine plan, numerous technical reports, and various information submittals. These stipulations, which will be applied to the approved action, represent the **minimum** amount of mitigation deemed necessary, at this point in time, in order to ensure compliance with WRC's sodium lease terms, which explicitly require protection of groundwater and oil shale resources. It is important to note that many of these stipulations, especially those within Sections 4.3.4, Well Drilling, Completion, and Abandonment; 4.3.5, Monitoring; and 4.3.6, Submittals, are contingent on, and may change based on data obtained during the experimental pilot-scale project and early stages of the commercial-scale project. The flexibility to change and/or revise stipulations, especially those operational stipulations within the above referenced sections that deal with technical and environmental uncertainties, is essential because of the innovative, unproven nature of the technology WRC will be employing, and BLM's responsibility for prudent management of the public lands. Thus, the identified operational stipulations may be modified as monitoring results indicate opportunities/needs for revision, so long as the mitigation objective is still met (i.e., impacts are mitigated as intended in the EIS impact analysis section and/or by the lease terms).

Any approval of a commercial-scale production alternative will contain a statement clearly specifying that, due to the nature of the technology to be employed, environmental impacts will be closely and carefully monitored. In compliance with the terms and conditions of the sodium leases and mitigation developed in this EIS, should this continuous monitoring indicate that significant impacts are occurring which were not anticipated in this EIS, the project will be shut down. BLM will then reassess the project, given the monitoring results, and determine whether additional mitigation will alleviate the impact or whether the project cannot be allowed to resume development.

4.3.1 General

If additional construction material is necessary for development associated with the approved action, the designated operator/lessee shall submit an application to the authorized officer for authorization to obtain such material, if located on public lands.

The designated operator/lessee shall locate, handle, and store gas, oil lubricants, and other petroleum products in such a manner so as to prevent them from entering into and contaminating water resources and soils on the public lands.

The United States of America considers the development of groundwater resources to be necessary and frequently indispensable to effective land management. The United States shall have the first opportunity to file a state water right for any intercepted groundwater. The designated operator/lessee may file for water rights within the lease, only with a written waiver from the District Manager. The Bureau of Land Management concedes the existence of any water rights that the Wolf Ridge Corporation and its affiliates may own or control before the date of approval of this mine plan.

The authorized officer shall be contacted at least 24 hours prior to:

1. Surface disturbing construction or maintenance activity
2. Commencement of reclamation activity
3. Commencement of drilling and logging operations

Rights-of-way will be required for the off-lease portions of ancillary facilities covered under the approved mine plan pursuant to Title V of FLPMA and Section 28 of the Mineral Leasing Act of 1920, as amended.

4.3.2 Air Quality

Periodic watering of the access roads, well field roads and plant site will be carried out to control fugitive dust emissions. This stipulation will apply particularly from May through October. The authorized officer may direct additional treatment of the road, as deemed necessary.

For the 500,000 TPY Alternative, fabric filtration shall be utilized for the additional materials handling steps of bulk product packaging and truck loading. A baghouse or electrostatic precipitator and flue-gas desulfurization shall be applied to the coal-fired boilers.

4.3 APPENDIX C

4.3.3 Evaporation Pond

The designated operator/lessee will be required to pump and haul waste water from the evaporation ponds to an approved disposal site if the evaporation ponds reach or exceed their design capacity, unless otherwise approved in writing by the authorized officer.

The liners of the evaporation ponds will be underlain by a minimum of 4 inches of suitable soil material containing at least 95 percent material passing the No. 10 sieve (ASTM E-11 specifications) or other approved method.

A watertight catchment basin or other approved method will be employed at the outlet of the leak detection system on each of the evaporation ponds to contain any leaked fluids.

A buffer zone of 15 feet of undisturbed vegetation will be maintained between the toe of the fill slope on the east side of the evaporation ponds and the edge of the adjacent major drainage.

Evaporation pond liner integrity will be maintained during periodic removal of solids. If the liner is damaged during solids removal operations, the liner shall be repaired to the satisfaction of the authorized officer.

4.3.4 Well Drilling, Completion and Abandonment

The annulus between the well bore and the 8 5/8-inch well casing will be filled with cement from the shoe of the 8 5/8-inch casing upward for 250 feet. Prior to horizontal drilling a Cement Evaluation Tool (CET) or equivalent log shall be run across this interval plus 100 feet above.

A "Notice of Intent to Abandon" will be submitted by the designated operator/lessee to the authorized officer before abandonment of any well developed within this project. The notice will contain an "as-built" diagram of the well and will describe any changes from the approved abandonment/plugging procedures. The authorized officer will review and approve or approve with modifications the notice within 15 calendar days of receipt. No special form for this notice is required. As a minimum, the following plugs will be required: 1) a steel bridge plug will be placed at the base of the production casing; 2) 100 feet of cement will be placed above this steel bridge plug; 3) a cement plug will be placed 20 feet above the Mahogany Zone down through to 120 feet into the Mahogany Zone and must be tagged to insure placement; and 4) 65 feet of cement will be placed at the surface. The intervals between the cement plugs will be filled with 9 pound/gallon or heavier mud. Other cement plugs or revised plugging procedures may be required, based on analysis of the cement evaluation logs. An appropriate surface hole location marker will be installed at grade.

Well spacing between cavities shall be adequate to ensure a 20-foot width at the top of the pillars that separate the cavities.

Diverter lines for the blow out preventer shall be directed into a lined mud pit at least 125 feet from the well.

Adequate waiting-on-cement times shall be observed for all cementing operations to achieve a minimum of 500 psi compressive strength.

Drilling fluid material will be contained in bentonite lined mud pits and hauled to evaporation ponds upon completion of drill holes, unless otherwise approved in writing by the authorized officer.

A yearly plan of development and summary of the activity for the previous year shall be submitted prior to initiation of project development and by February 1 of each year thereafter. The plan will include the following items:

1. Summary of the activity for the previous year including, but not limited to,
   a. Any new findings or developments,
   b. Acres disturbed, acres reclaimed,
   c. Wells drilled, plugged, converted to monitoring, etc.,
   d. Hydrologic monitoring.
2. Proposed operations for the coming year, including, but not limited to,
   a. Location and number of new wells to be drilled,
   b. Well field piping system layout, including location of pressure transducers, 6-inch drain line connection points, and valves.
   c. Number of acres to be disturbed and to be reclaimed.
3. Status of all surface facilities and wells not abandoned.
4. Any technical considerations and/or proposed changes in approved operations.
5. Map of mined-out cavities and identification of any subsidence areas.

Prior approval is necessary for any change made to informational submittals, monitoring, or approved operations.

4.3.5 Monitoring

Weekly monitoring of the mud gel in the annulus between the 13 3/8-inch surface casing and 8 5/8-inch well casing will be required and any observed changes and/or any remedial measures taken shall be reported monthly to the authorized officer.

The designated operator/lessee will be required to complete a certain number of wells as dedicated hydrologic monitoring wells. These wells will supplement the proposed monitor wells and will be located outside the well field and zone of influence of subsidence, so they are effective throughout entire mine life. The number and location of the dedicated hydrologic monitoring wells will be submitted by the applicant and approved by the authorized officer before initiating construction of the approved action. Monitoring of the groundwater will commence at least 6 months prior to the start of mining.

The designated operator/lessee will be required to monitor four groundwater zones: the unconfined water bearing zone (perched aquifer), the A-groove of the upper aquifer, the base of the lower aquifer, and the B-groove of the lower aquifer. The monitoring well(s) shall be equipped with a continuous graphic or other appropriate water level recorders. The well(s) shall be sampled two times, 1 week apart, for major and minor components, as soon as completed and cleaned out properly. Sampling for major components will be conducted at least once a month beginning 6 months prior to and continuing throughout mining operations, and minor components will be sampled annually. Monthly sampling shall continue for a period of up to 3 years (at the discretion of the authorized officer) after project cessation. Any deviation from baseline condition effects detected within the monitored zones during operations shall be reported to the authorized officer. Sampling frequency will be increased to at least once a week if effects to the monitored zones are recorded. The weekly samples will be analyzed for the field measurements and major components. The first weekly sample will be analyzed for minor components. If significant deviations from the baseline are recorded in the minor components, analysis of samples for minor components will continue. Analysis for only those minor components which show a significant deviation from baseline will be required.

Unless otherwise authorized by the authorized officer, the well(s) shall be sampled for the following:

Field Measurements (Monthly)

temperature	pH	conductivity

Lab Analyses - Major Components (Monthly)

total dissolved solids

alkalinity	sodium	bicarbonate	carbonate

Minor Components

(Sample initially and if aquifer system is affected)

arsenic	aluminum	cadmium
manganese	selenium	barium
chromium	nickel	vanadium
beryllium	copper	strontium
molybdenum	bismuth	lead
zinc	mercury	bromide
lithium	nitrate	calcium
sulfide	magnesium	fluoride
potassium	total phosphate	sulphate
boron	silica	iron
chloride	dissolved organic carbon	

Lab analysis work must be performed by a laboratory approved by the authorized officer.

If leakage (brines) from cavities exceeding State of Colorado standards for total dissolved solids is detected in the base of the lower aquifer, the operator will be required to (1) perform remedial action such as extracting the brines and disposing of them through surface treatment, evaporation, or deep well injection at approved facilities, and/or (2) contain the brines within the base of the groundwater system and within the boundaries of the sodium leases, as determined by the BLM authorized officer.

The designated operator/lessee shall establish surface water monitoring stations for water quantity and quality as required by the authorized officer, upstream and downstream of the cone of depression on the main channels of Yellow and Piceance creeks. Data collected at the stations shall include continuous streamflow and precipitation records and comprehensive water quality analysis for all field measurements and major and minor components conducted on a quarterly basis. Data collected shall commence 6 months prior to start up and shall continue throughout mining operations as directed by the authorized officer. Should recorded water quality data deviate significantly from baseline, sampling frequencies may increase as directed by the authorized officer.

The lessee shall compile an inventory of all springs and seeps within the cone of depression and monitor for water quantity and quality. Water quantity of springs shall be monitored monthly for 6 months prior to and during mining

operations. Water quality shall be sampled quarterly for field measurements and major and minor components starting 6 months prior to mining operations. Field measurements shall be monitored quarterly with major and components sampled annually during mining operations. Should quantity or quality of any springs or seeps deviate significantly from baseline, sampling intensity and frequencies may increase as directed by the authorized officer. The number and location of surface water monitoring stations and spring sites shall be submitted by the applicant to the authorized officer for approval.

The designated operator/lessee shall submit a quarterly hydrologic monitoring report to the authorized officer. Any significant changes to hydrologic system shall be reported within 10 working days after being detected.

Discharge of water will not be allowed without prior written approval from the authorized officer of BLM.

A detailed subsidence monitoring system will be submitted by the designated operator/lessee to detect and determine:

1. Extent of caving
2. Impact on Mahogany Zone due to caving and/or pillar failure
3. Any surface subsidence
4. Actual cavity configuration

This design will be submitted to the authorized officer for approval. The authorized officer will approve or approve with modifications or disapprove the design within 30 days of receipt. The subsidence monitoring system will be in operation prior to sodium production and will continue for at least 3 years following project cessation, or longer if conditions warrant, as determined by the authorized officer.

4.3.6 Submittals

The following information shall be submitted to the authorized officer within 30 days after such data is obtained:

1. One copy of all hydrologic data obtained from drilling and monitoring
2. Copies of all downhole logs
3. Fluid injection and production volumes and corresponding pressures
4. The daily 5 ½-inch by 8 ⅝-inch annular pressure readings
5. Copies of the mud check sheets
6. Weekly monitoring data of fluid levels in the 13 ⅜ -inch by 8 ⅝-inch annulus

The Cement Evaluation Tool (CET) log or equivalent shall be submitted to the authorized officer within 10 days after logging.

Production from a cavity shall be stopped if production from the cavity meets the calculated production, based on the assumed cavity configuration.

Specific details and specifications for epoxy spray coatings or other remedial measures of minor casing leaks will be provided to the authorized officer for approval before initiating well construction.

The authorized officer will be notified of all spills, leaks and pressure losses within 24 hours of the occurrence during the week, or first thing Monday morning if the occurrence is on a weekend.

4.3.7 Reclamation

Interim reclamation measures may be necessary before project cessation, as determined by the authorized officer. In addition, erosion control measures may be necessary, as directed by the authorized officer.

Topsoil will be stripped to appropriate depths on all areas that will be disturbed by the proposed action and will be stockpiled for future restoration, as directed by the authorized officer. Topsoil stockpiles will be fenced with single strand wire and will be appropriately shaped, i.e., slopes 4:1 or less, to minimize erosion before seeding and to maximize vegetation establishment after seeding. Stockpiles will be adequately designated with signs. Topsoil shall not be used as pipeline padding or mixed with spoils.

Whenever possible, salvaged topsoil will be applied directly to recontoured areas, reducing to the greatest extent possible, long-term topsoil stockpiling.

Topsoil stockpiles and exterior cut and fill slopes of evaporation ponds will be seeded, as soon as possible, with the following interim reclamation seed mix to enhance viability of stockpiled topsoil and to minimize potential erosion problems with both stockpiles and evaporation pond:

Species	Variety	Pounds Pure Live Seed/Acres
GRASSES		
Pubescent wheatgrass	Luna	4
Thickspike wheatgrass	Critana	2
FORB		
Alfalfa	Ladak *	2

* preinoculated

Wherever possible, at least 12 inches of topsoil will be reapplied to disturbed areas after recontouring. When topsoil availability precludes a 12-inch application rate, as much topsoil as is available will be applied, but in no case will reapplied topsoil depth be less than 6 inches.

Reclamation will be initiated as soon after disturbance as possible, or as directed by the authorized officer.

Surface disturbing activities shall not be performed during periods when the soil is too wet to adequately support equipment. If equipment creates ruts in excess of 3 inches deep, the soil shall be deemed to be too wet to adequately support equipment. Mud blading is not considered an alternative to meeting the criterion in this stipulation.

Blading of vegetation or surface leveling of the area between wells comprising a well pair will not be allowed without prior documented authorization from the authorized officer.

The designated operator/lessee will be responsible for monitoring reclaimed areas for at least three complete growing seasons after final reclamation work is completed. Monitoring will continue to be required until reclamation goals are successfully achieved and reclamation qualifies for bond release. Monitoring methods are subject to the approval of the authorized officer and will quantify the following elements (at a minimum):

1. Vegetative production
2. Crown cover
3. Plant composition

Reclamation will be considered for approval and bond release only after the results of monitoring are presented to BLM. Reclamation will be considered a failure and remedial measures required prior to bond release if one or more of the following conditions persist:

1. Production of herbaceous perennial species by category (forb, grass) is less than that measured on representative undisturbed areas.
2. Shrubs comprise less than 12 percent and perennial forbs less than 4 percent of the established plant composition by cover.
3. Perennial crown cover is less than that measured on representative undisturbed areas.
4. Soil erosion rates on reclaimed areas exceed those of representative undisturbed areas.

All merchantable forest products within the project development area that are taken, damaged, or destroyed will be purchased by the designated operator/lessee at the total appraisal price, to be determined by the authorized officer, Bureau of Land Management (BLM), White River Resource Area. Disposal will be as follows:

All stems, stumps and branches over 4 inches in diameter shall be: a) removed from federal land for resale or private use, or b) cut into lengths not exceeding 4 feet and scattered away from the disturbance. All stems and branches less than 4 inches in diameter shall be evenly scattered away from the disturbed area.

Annual or noxious weeds shall be controlled on all disturbed areas as directed by the authorized officer. Method of control shall be by an approved mechanical method or an EPA registered herbicide. All herbicide application proposals must be under direct field supervision of an EPA certified pesticide applicator.

The species mixture submitted in the mine plan for use in reclamation is amended as follows:

Species	Variety	Pounds Pure Live Seed/Acres
GRASSES		
Thickspike wheatgrass	Critana	0.50
Streambank wheatgrass	Sodar	0.50
Western wheatgrass	Arriba	1.00
Pubescent wheatgrass	Luna	0.50
Basin wildrye	Magnar	0.50
Russian wildrye	Vinall	0.50
Green needlegrass	Common	2.00
Orchardgrass	Paiute	0.25
FORBS		
Lewis flax	Apar	0.20
Cicer milkvetch	Monarch *	0.50
Alfalfa	50% Ladak *	0.75
	50% Nomad *	0.75
Small burnet	Delar	1.00
SHRUB		
Fourwing saltbush	Rincon (dewinged)	1.50
Winterfat		0.50
Antelope bitterbrush		1.00

* preinoculated

4.3 APPENDIX C

The quantity of seed applied on-the-ground will be determined on a Pure Live Seed (PLS) basis, PLS being defined as "tested purity rate" x "tested rate of germination." For example, the quantity of western wheatgrass seed (95 percent purity, 70 percent germination) needed to meet a stipulated 1.0 pound PLS/acre application rate:

Actual applied seed rate = required PLS rate (lb per acre) ÷ PLS index = 1.0 lb per acre ÷ 0.9 x 0.70 = 1.5 lb per acre

Site-adapted, tested seed for the current year is required and is subject to the approval of the authorized officer (copies of the seed labels will be furnished to the authorized officer).

Specific cultural practices that promote the establishment and survival of seeded forbs and shrubs will be employed where practicable, subject to the approval of the authorized officer.

On-site burial of concrete or asphalt at the time of sodium mine site decommissioning is subject to prior approval of the authorized officer.

The designated operator/lessee shall promptly remove and dispose of all waste to an approved landfill, as directed by the authorized officer. The term "waste" as used herein means all discarded matter including, but not limited to, human waste, trash, garbage, refuse, petroleum products, ashes, and equipment.

Drainages shall not be blocked with loose dirt or debris.

Before termination of the authorized facilities, the designated operator/lessee shall contact the authorized officer to arrange a joint inspection of the facilities and disturbance. The inspection will be held to determine if any reasonable and necessary changes, revisions, or additions need to be made to the approved restoration and rehabilitation plan.

Reclaimed areas will be fenced off with four strand barbed wire fence with braced corner posts conforming to BLM Type D fence specifications (Appendix A of the draft EIS). Reclaimed areas shall remain fenced so as to effectively exclude livestock use for a minimum of three complete growing seasons following final reclamation work and until bond release is approved by the authorized officer.

4.3.8 Range and Wildlife

All powerlines and electric transmission facilities (aboveground) will conform to accepted raptor protection design criteria as presented in: *Suggested Practices for Raptor Protection on Powerlines—State of the Art in 1981*, Raptor Research Report No. 4, Raptor Research Foundation, c/o Carpenter St. Croix Nature Center, 12805 St. Croix Trail, Hastings, Minnesota 55033.

Upon completion of BLM's Section 7 Consultation requirements with the U.S. Fish and Wildlife Service, any threatened and endangered species conservation measures developed through the Section 7 Consultation process will be required of the designated operator/lessee.

In the event any raptor nest site is encountered during facility siting or well field construction, the designated operator/lessee shall notify the authorized officer immediately. Appropriate mitigative measures will be formulated at this time by the White River Resource Area Manager, as necessary.

Where the authorized officer determines that consumption of contaminated water will be detrimental to animals, the designated operator/lessee shall prevent access by appropriate fencing with 8-foot high woven wire or chain link fence. The evaporation ponds shall be fenced in this manner.

The applicant will be responsible for offsetting short-term mule deer habitat losses associated with well field development and life-of-mine facilities. Under the direction of BLM, the designated operator/lessee shall be responsible for implementing mule deer habitat enhancement practices within the Piceance Basin at 5-year intervals through mine life. Habitat enhancement measures will be based on the extent of mule deer habitat lost or made unavailable over each 5-year period, from the first year of development through the end of mine life (Environmental Consequences, Mule Deer). Specific practices that would be considered include, but are not necessarily limited to:

1. Mechanical brush manipulation
2. Range seeding
3. Prescribed burns
4. Water developments

The performance goal for mule deer habitat mitigation shall be to replace forage resources effectively lost over each 5-year period. BLM and the designated operator/lessee, in coordination with the Colorado Division of Wildlife, will appraise habitat losses, determine habitat enhancement needs, and formulate project methodology and design. All mitigation work will be subject to the approval of the BLM.

The designated operator/lessee shall be responsible for conducting annual raptor breeding activity inventories in pinyon-juniper habitats affected by well field development through mine life. These surveys shall be conducted by qualified personnel with demonstrated training and practical field experience in raptor behavior and breeding biology. The surveys will be conducted during May or June of each year and will encompass a study area which is comprised of that portion of the well field which would be affected 2 years in advance of current mining activity and a 500-

foot buffer around the principal study area. Results of annual inventory will be furnished to BLM by September 1 of each year. The designated operator/lessee shall be responsible for executing emergency or remedial mitigation for newly initiated or previously undiscovered raptor nesting activity jeopardized by well field development, as directed by BLM in coordination with the U.S. Fish and Wildlife Service.

No unnecessary removal of pinyon pine or Utah juniper trees or snags will be allowed within the well field, particularly in that area between wells comprising a well pair. One year prior to preparative clearing of sites within the well field, individual trees which require removal must be identified for inspection and their removal approved of by the authorized officer and/or White River Resource Area wildlife biologist.

Prior to approval of the 500,000 TPY Alternative, BLM will require the applicant to perform additional hydrologic evaluations as a means of quantifying surface water impacts related to incorporation of an additional process water well, and as the basis for revising the wetland related impact assessment. Based on revised impact analyses, BLM will insert a mine plan stipulation requiring the applicant to fully compensate long and short-term losses of wetland values attributable to mine activities. The methods, extent, and location of mitigation practices used in offsetting wetland impacts will be subject to the approval of the BLM.

4.3.9 Archaeology/Paleontology

In consultation with the Colorado State Historic Preservation Officer (SHPO), it has been determined by BLM that the following sites: 5RB2500, 5RB1923, and 5RB410, are potentially eligible for listing on the National Register of Historic Places (NRHP). It has also been determined that further data collection will be required to make a final determination of eligibility for these sites. Therefore, before beginning any construction which could affect these sites the lessee must, at its expense, collect sufficient data to enable SHPO to make a determination of eligibility. The contractor selected to gather this information must have a valid BLM permit and all testing plans must be reviewed and approved by BLM and SHPO prior to initiation of any excavations.

Should any or all of the three sites listed above be determined eligible for listing on the NRHP, the lessee will prepare a mitigative data recovery plan to retrieve the scientific data contained in the sites. Persons conducting mitigative field work must have a valid excavation permit issued by BLM. The data recovery plan must be developed in accordance with the Secretary of the Interior's guidelines for the treatment of archaeological properties. All mitigative data recovery plans are subject to review and approval by BLM and SHPO. Mitigation must be completed before construction within the site boundaries begins.

If in its operations, the designated operator/lessee discovers any cultural remains, monuments or sites, or any object of antiquity subject to the Antiquities Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. Sec., 431-433), the Archaeological Resources Protection Act of 1979 (Public Law 96-95), and 43 CFR, Part 3, the designated operator/lessee shall immediately cease activity and report directly to the Area Manager. BLM will then take necessary action to comply with the above legislation. The designated operator/lessee shall follow the mitigative requirements set forth by the BLM concerning protection, preservation, or disposition of any sites or material discovered. All known and identified sites will be avoided by project design. If this is not prudent and feasible, consultation with the State Historic Preservation Officer (SHPO), as specified in 36 CFR 800, will be required. In cases where mitigation is necessary, the cost of such mitigation shall be borne by the designated operator/lessee, unless otherwise agreed upon.

The designated operator/lessee shall not knowingly disturb, alter, destroy, or take any fossils of significant scientific interest, and shall protect all such fossils in conformance with the measures included in the approval of the mining plan.

The designated operator/lessee shall immediately report any such fossils that might be altered or destroyed by his operation to the attention of the District Manager. Operations may continue as long as the fossil specimen or specimens will not be seriously damaged or destroyed by the activity. The District Manager shall evaluate or have evaluated such discoveries brought to his attention and, within five working days, shall notify the designated operator/lessee what action shall be taken with respect to such discoveries. All such fossils of significant scientific interest shall remain under the jurisdiction of the United States until ownership is determined under applicable law. Copies of all paleontological resource data generated as a result of the lease operations will be provided to the District Manager. The cost of any required salvage of such fossils shall be borne by the designated operator/lessee. These conditions apply to all such fossils of significant scientific interest discovered within the lease area.

4.3.10 Roads and Pipelines

For the 50,000 TPY Alternative, access road upgrading shall be constructed and maintained in accordance with BLM

9113 guidelines and Class D-Mountainous Rio Blanco County Road standards.

For the Proposed Action (125,000 TPY) and 500,000 TPY alternatives, access road upgrading shall be constructed and maintained in accordance with BLM 9113 guidelines and Class C-Mountainous Rio Blanco County Road standards.

The designated operator/lessee shall regularly maintain the road in a safe, usable condition. A regular maintenance program shall include, but not be limited to, blading, crowning, ditching, culvert installation, drainage installation, surfacing, and patrolling.

The designated operator/lessee shall post signs, visible within line of sight, indicating location of the underground water pipeline and electric cable, providing name, address, and telephone number of a responsible contact person.

All pipelines adjacent to or crossing access roads shall either be buried with a minimum of 4 to 5 feet of cover in alluvial areas and a minimum of 3 feet of cover in rocky areas, or they will otherwise be protected from road maintenance and construction activity.

Culverts and/or other measures may be necessary to control surface water runoff from the access road and adjacent areas so as not to impede natural drainage or create erosional hazards. Placement and construction is subject to direction and/or approval by the authorized officer.

Operator shall paint all permanent structures (on site for a period longer than 90 days after construction) a flat, noncontrasting color harmonious with the adjacent landscape. Exceptions to this requirement are small structures that are not readily visible from a distance of approximately 1/4 mile such as wire and small pipe or structures which, because of OSHA requirements, require safety coloration. Specific colors appropriate for the various landscapes are Cypress Gray, 11-M-38, or equivalent.

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